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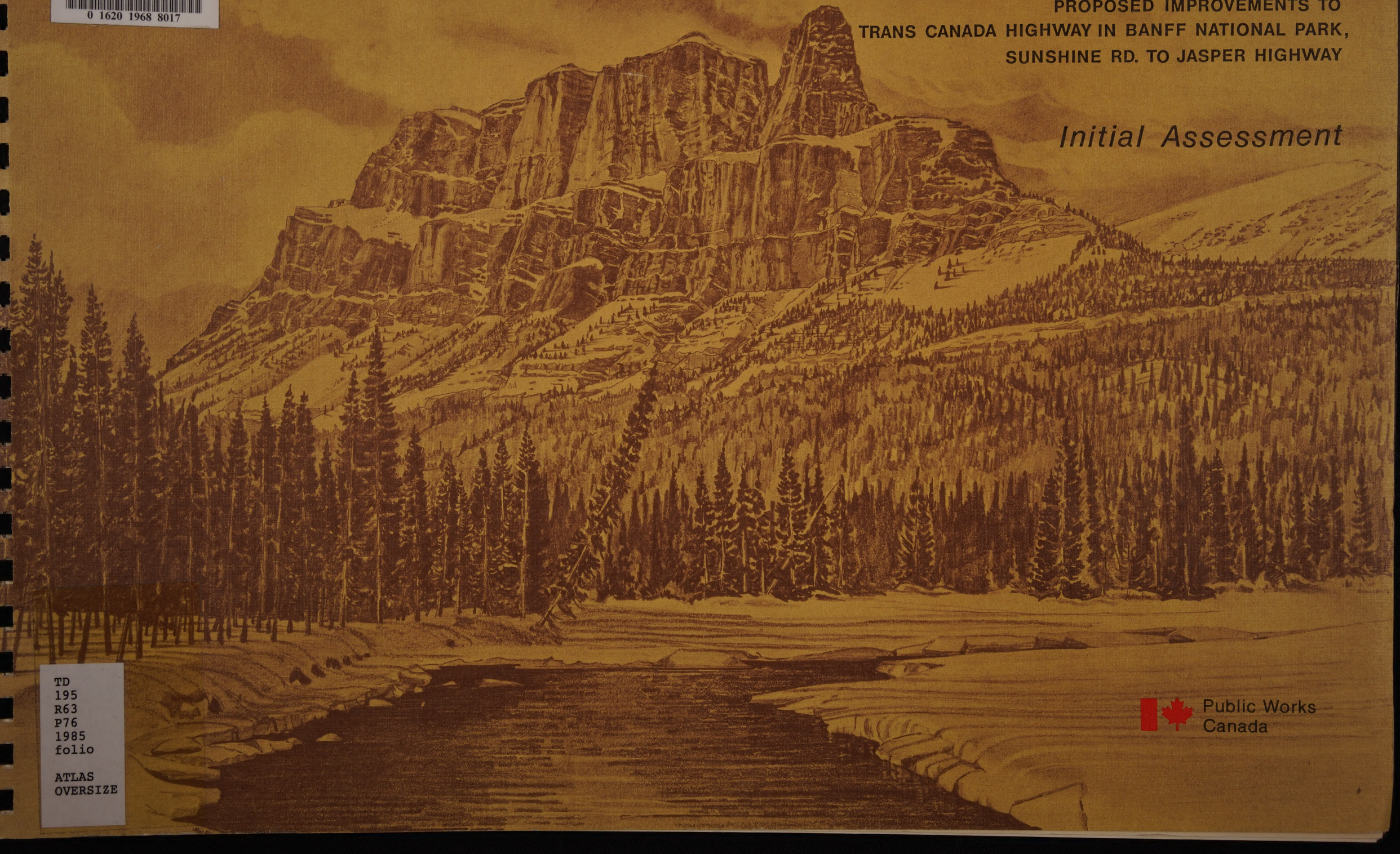
Initial Assessment



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PROPOSED IMPROVEMENTS TO
THE TRANS CANADA HIGHWAY IN BANFF NATIONAL PARK,
SUNSHINE RD. TO JASPER HIGHWAY

Initial Assessment

August 1985

Public Works Canada

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SUMMARY AND CONCLUSIONS

INTRODUCTION

The existing highway through Banff National Park is part of the Trans Canada Highway (TCH) system which extends from St. John's, Newfoundland to Victoria, British Columbia. The TCH is Canada's prime east-west transportation route and is the main access highway into Canada's mountain parks. It also connects with Highway 93 which leads to Jasper National Park to the north and Kootenay National Park to the south. West of Banff National Park, the TCH traverses Yoho, Glacier and Mt. Revelstoke National Parks in B.C. on route to the west coast.

Public Works Canada is proposing to make further improvements to the TCH through Banff National Park. Phase III will extend from km 26 at Sunshine Road to km 75 at the Icefields Parkway Interchange (Hwy. 93). The improvements will comprise upgrading the existing highway to four traffic lanes. Phase I covered the highway improvements extending from East Gate to km 13; Phase II covered the section from km 13 to Sunshine Road. As of this date, Phase I is virtually complete and Phase II is scheduled for completion in 1986.

The objective of the proposed improvements is to provide a functional, efficient, safe and aesthetically pleasing highway which will meet present and future user demands, and be environmentally acceptable.

DECLARATION

Public Works Canada[1] is the sponsor of this Initial Assessment and is responsible for its statements and judgements.

The assessment was carried out by Public Works Canada personnel in conjunction with specialists from consultant firms (see references).

THE NEED

Traffic volumes on the Phase III section of the TCH in 1983 ranged from 4320 to 6390 average annual two-way daily traffic (AADT). Since the 30th highest hour in the year is about 20% of the AADT, for 30 hours per year the hourly traffic exceeded 860 (west of Lake Louise) and 1280 (Near Sunshine). By the year 2005, these volumes can be expected to grow to respectively 8290 and 12240 daily, and 1660 and 2450 for the 30th highest hour. Using desirable levels of service criteria, the 30th highest hour traffic volume should not exceed 900 vehicles per hour. Thus, this criteria is already exceeded for all but the section west of Lake Louise.

The maximum "possible" capacity of the two-lane road (1500 vehicles per hour) is also currently exceeded a few hours annually, and this can be expected to grow to about 500 hours per year by the year 2005.

Two economic studies give favourable benefit-cost ratios appreciably greater than unity for the proposed Phase III improvements.

Thus the proposed improvements described in this report can clearly be justified from the standpoint of both accommodating traffic and economic efficiency.

ALTERNATIVES TO TWINNING

The discussion of various alternatives provided in the Phase II EIS still applies. In addition the following points are applicable to Phase III.

Separate Routing of Through Traffic and Park Traffic (The Parkway Concept)

The parkway concept has the advantage of separating a portion of the Park visitor traffic from the through-traffic on the TCH resulting in a safer driving environment for both groups. Thus a measure of relief from traffic congestion is provided.

The disadvantage of the parkway concept as applied to this project is that the potential for relief of traffic congestion is minor. Because of the limited capacity of the Parkway, any significant relief is not possible (DeLCan, 1982).

The No-Build Alternative

Traffic congestion is expected to become increasingly more serious on the study section of the highway if the capacity of the highway is not increased. Peak traffic volumes are already well above design requirements over most of the section. By the end of the decade the lengthy periods of delay caused by congestion would incur a real economic cost on commercial traffic and business travellers, and an indirect cost on all other travellers.

The most noticeable impact would be felt by the Park visitor. Progressively increasing congestion of traffic for several hours at a time would cause the highway to take on the appearance of a rush hour urban roadway, a condition not approriate in a National Park or on Canada's major east-west highway.

DESCRIPTION OF PROPOSED IMPROVEMENTS

The existing highway between kilometres 26 and 75 is a rural paved two-lane undivided highway with a design speed of 110 km/hr and posted speeds of 90 and 70 km/hr. The total width of the pavement is 13.4 m comprised of two driving lanes each 3.7 m wide and paved shoulders each 3.0 m wide. The width of the right-of-way is 61 m. Structurally, the highway is continuing to perform well. There is no evidence of the rutting, warping, alligator cracking or pot holing that might be expected with a 20 year old facility. The most noticeable defects are cold temperature transverse shrinkage cracks, which are a common problem encountered in most older pavements in Canada.

A visual appreciation of the highway and the terrain it crosses is provided in the body of this report by the topographic plan in Figure 2.1-1 and the display of oblique aerial photographs in Figure 2.1-2.

The objective of the proposed improvements to the TCH is to alleviate the growing congestion and improve the safety of the facility, incorporating good engineering practice and sensitive environmental design. The proposed road would be a four lane divided highway with a design speed of 100 km/hr and a posted speed of 90 km/hr. An over-riding concern in the preparation of this proposal is to minimize possible adverse environmental effects. Roadway cross sections consistent with highway safety are proposed and the new roadway would be carefully fitted to existing topography. The roadway design would be based on accepted standards published by the Roads and Transportation Association of Canada.

The proposed four lane highway would consist of the existing pavement where possible (two lanes, two shoulders) plus two additional 3.75 m driving lanes, a 3.0 m outside shoulder and a 1.5 m inside shoulder. The lanes would be separated by a grassed median (cross section Type A), or a treed area (cross section Type B), or a concrete barrier (cross section Type C or Type D). Typical sections are shown on Figure 2.2-1.

A preliminary layout is shown on Figure 2.2-2. The layout has been prepared for the purpose of this Initial Assessment only. The location of the alignment can be readily adjusted. For example, west of Castle Mountain Interchange the separation of the new lanes from the existing highway may be increased from that shown at various locations and a curvilinear alignment may be introduced. Also at those locations where the alignment is limited by high land to the south and the Bow River to the north, a decision is to be made on the extent of cut versus fill encroachment on the river. The proposal shown involves approximately 18 km of grassed median, 19 km of wide treed median, and 7 km of concrete barrier. A new modified diamond interchange is proposed at the Castle Mountain junction, (Figure 2.2-2, Sh. 6) but no change to the existing Icefields Parkway Interchange is planned.

Between km 28.5 and km 33, an alternative alignment is being considered. This alignment (Figure 2.2-2, Sh. 1) is located 50 to 100 m south of the present highway and higher

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1 Address: Public Works Canada, Western Region, 9925 - 109 Street, Edmonton, Alberta, T5J 2K1.

up the slope. Other alignments to the south are being considered.

The TCH Improvements will be carried out by Public Works Canada under the supervision of the Western Region Office. Design and supervision of construction work will be the direct responsibility of Public Works Canada, the same agency that was responsible for the design and construction stages of the existing highway.

Construction of the improvements to the TCH is scheduled to take place over a period of seven years. The work is expected to progress as shown in Figure 2.3-1. This schedule is dependent upon the availability of funds.

The major portion of the work would be completed by the end of the fifth year followed by completion of the remaining paving in year six and completion of miscellaneous items in year seven.

Manpower and cash flow requirements are also summarized on Figure 2.3-1. The total estimated cost of construction is $74.5 million in 1985 dollars.

Due to the distance of this project from developed areas of Canmore and Banff, the prime contractors may elect to use camps within the Park. Location of camps within the Park would be provided by Parks Canada. The camps will be managed by Public Works Canada.

During construction, highway travellers will be subject to traffic disruptions. Construction equipment will be working adjacent to the existing highway and reduced speed limits will be posted in these areas. Flagmen will be used at any locations of direct interference between construction equipment and highway traffic. Crossover points, where lanes switch across the existing highway, will be constructed late in the schedule and will have cold mix laid immediately after construction.

An extraction and rehabilitation plan covering all new borrow areas will be prepared for acceptance by Parks Canada. A similar rehabilitation plan will also be developed and implemented for old borrow pits which are traversed by the new construction and which are visible by previous construction but which are not visible from the highway will be rehabilitated as is necessary to compensate for habitat lost to highway construction. All rehabilitation requirements will be defined by a program prepared by Parks Canada in collaboration with Public Works Canada.

APPLICABLE ADMINISTRATIVE PROCEDURES AND REGULATIONS

Previous Environmental Assessments

In May 1978, Public Works Canada (PWC) referred the proposed twinning of the Trans Canada Highway (TCH) from East Gate to Sunshine Road to the Federal Environmental Assessment Review Office (FEARO). In 1979, following the preparation of the Environmental Impact Statement (EIS) for the section from East Gate to km 13 (Phase I), the hearing was held and the Panel subsequently submitted their recommendations to the Minister of Environment that the project proceed.

In 1981, PWC submitted an EIS covering Phase II, km 13 to Sunshine Road, and in early 1982 a second formal Panel hearing was held. The Panel recommended that four-laning the highway from km 13 to km 23 (the Bow Valley Parkway junction) proceed but that a decision on twinning of the TCH beyond km 23 be postponed pending further study. These studies were subsequently carried out by PWC and Parks Canada and later in 1982 they jointly agreed to proceed with construction up to km 27.

Environmental Management of Construction to Date

Construction to date has been "fast-tracked" in accordance with the following schedule:

a) Phase I commenced 1981 and was largely completed 1984.

b) Phase II commenced 1983 and will be virtually complete 1985.

c) The Norquay Interchange was completed in 1984 and Minnewanka, Bow Valley Parkway, and Sunshine interchanges will all be completed by 1985.

Thus, the total construction for Phases I and II has taken five years.

PWC recruited a full-time environmental coordinator residing at the job site (the former Chief Warden of the Park). PWC also established an environmental committee structure comprising six entities. This committee structure is shown on Figure 4.2-1.

From the standpoint of environmental management of the project, it appears that the Environmental Subcommittee has been the most active. In particular, a good and meaningful working relationship has been established between this subcommittee and project management. There is now little doubt that effective communication between PWC and Parks Canada exists on the project. This was an original concern of the Panel (FEARO, 1979, p. 39).

Applicable Administrative Procedures and Regulations

This environmental assessment is being carried out in accordance with the Federal Environmental Assessment and Review Panel (EARP). A new EARP Guideline Order was issued in June 1984. In accordance with the above procedure, PWC prepared an Environmental Screening report (April 1985) which was reviewed by the Senior Committee of the TCH Improvements Project. It concluded that an Initial Assessment (formerly called an Initial Environmental Evaluation or IEE) was warranted.

Other applicable procedures and regulations are summarized in Section 4.3 of this report.

Public Concern

The level of public concern over Phase III is not expected to be high, for the following reasons:

- In contrast to Phases I and II, which were in close proximity to Banff and the Vermilion Lakes, has not identified any new or sensitive environmental concerns in Phase III.

- Phase III is a continuation of construction that began in 1981. The unprecedented aspects of Phases I and II no longer apply. The public has lived with the construction work and has seen the results. There has been little reported negative response.

- The management of the project (including environmental management) and communications with the general public have been good.

- The public will have the opportunity to review and comment on this Initial Assessment.

Proposed Environmental Management of Phase III

Public Works Canada will retain the same environmental committee structure as was developed for Phases I and II. The position of the Environmental Coordinator responding to the Project Manager will be maintained. It is anticipated that many of the personnel involved with environmental management of Phases I and II will go on to Phase III, thus ensuring continuity.

Detailed environmental studies as identified in the sections entitled "Additional Work" in Part 5 of this Initial Assessment will be undertaken on a sector by sector basis, as part of detailed design. Specialists from the private and public sectors will be utilized.

Monitoring of environmental concerns and mitigating measures during construction will be carried out by Public Works Canada in collaboration with Parks Canada and the constituted committees.

POTENTIAL ENVIRONMENTAL IMPACTS AND THEIR MITIGATION

Terrain

Enlargement of existing sidehill cuts and construction of a number of new cuts to accommodate proposed improvements to the TCH are identified as the most significant adverse impacts on terrain. Additional cuts can be expected if an alternative southern alignment is selected. It is concluded that implementation of selected remedial measures and mitigative procedures adopted for Phases I and II, as well as those used during the original construction of this section of highway, will do much to address these concerns. Two areas, near Castle Mountain Interchange and in the vicinity of km 65, exhibit evidence of shallow rational and flow sliding. These failures are related to adverse (high) groundwater conditions in combination with overly-steep cut

slopes. Further work is recommended with respect to mitigating the current problems at these locations. An additional survey will be required for an alternative southern alignment.

Stream Regimes

Potential impacts on water bodies involve a number of contacts with the Bow River (Table 3.2-3), contacts with two wetland areas, and crossings of some 16 streams including the Bow River near Lake Louise.

No further encroachments on the Bow River are presently contemplated, but there are two locations where additional encroachment should be considered as an alternative to high sidehill cuts, at approximately km 51.5 and km 55.5. There is an opportunity for improving previous re-channelization at these points.

Encroachments on wetland areas will be slight but cannot easily be mitigated.

The most significant stream crossing impact is at Altrude Creek near the proposed Castle Mountain Interchange. In order to avoid a long culvert crossing, alternative layouts including a stream diversion alternative will be considered. The problem of blockage by icings will be taken into account in sizing the bridges and culverts.

It may be possible to reduce in-stream maintenance at a few crossings by bank stabilization in the vicinity of the highway.

There is no evidence of problems such as debris torrent activity that require special measures in stream crossing design. The capacity of all existing stream crossing structures appears to have been adequate for flows experienced, and may in some cases appear excessive for expected flood flows. In view of the possibilities of blockage by ice and coarse sediment, however, careful consideration will be given to any design that involves a reduction of existing capacities.

Air Quality

The main impacts will be temporary. Dust raised by construction activities or through the use of temporary unpaved detours will effect the particulate concentration in local areas. This problem will be mitigated through the use of water spraying and the temporary asphalt paving of certain (longer-term) detours.

All asphalt paving plants will comply with emission control regulations.

Local air quality during operation of the new highway will be little changed, except for improved conditions during periods when traffic congestion would have otherwise occurred.

Vegetation

Much of the project area affected is within lodgepole pine woodland and abandoned borrow pits which have very low vegetation significance. Of the vegetation types with higher significance, approximately 2.8 km of open wetland vegetation along the highway (mostly on the north side of the alignment) and 7.7 km of moist spruce woodland could be affected. Only 0.1 km of significant dry slope vegetation will potentially be affected. The area is mostly covered by immature forest and no large specimen trees were observed in the field survey for this Initial Assessment.

The overall impact of the proposed improvements on the significant vegetation resources of the valley will be low due to the preponderance of dry lodgepole pine.

Specific impacts on the more significant spruce and wetland vegetation can be reduced through mitigation such as carefully controlled construction, transplanting and re-creation of similar habitat, and minor changes in alignment to avoid the most important sites.

General impacts on vegetation can be reduced principally through appropriate location of construction-related activities, sound reclamation practices and attention to maintaining drainage patterns.

Further studies are required to establish the populations of significant plant species and to detail the mitigation approaches which need to be taken.

Fish Resource

The proposed highway will cross eight fish bearing tributary streams (Table 3.5-2), excluding the Pipestone River where improvements are already underway. The most significant fish resources in the study area occur in Altrude Creek and in the Bow River. Bridging the Bow River with a structure similar to the existing structure can be expected to have limited impact on aquatic resources. Altrude Creek will require special precautions to avoid significant impacts to fish. This creek is adjacent to the Castle Mountain Interchange. Present plans indicate that it is to be crossed by both eastbound and westbound lanes of the TCH and by eastbound entrance and westbound exit ramps (Figure 2.2-2, Sh. 6-). This combination of crossing is a primary concern for fish passage. Other stream crossings or aquatic habitat intersections are of lesser concern but will require preparation of specific mitigative measures.

Mitigative measures applied to the previous TCH phases are also applicable to Phase III. These measures are well documented in the Phase II EIS and are not repeated here. For Phase III construction, maintaining small channel or seepage flows into wetland areas will also be required.

There appear to be no non-mitigatable impacts on any fish bearing streams. Alternative designs for the multiple Altrude Creek crossing will be explored to minimize impacts on the resource. The stream may be diverted either to the west so that the crossed sections of the stream may be separated or to the east where the crossing is reduced to an acceptable length. Care will also be exercised during the construction of the Bow River bridge to prevent contaminants or excessive amounts of silt from reaching the river.

It can be concluded that impacts on aquatic resources as a result of highway construction are expected to be low after mitigation techniques are applied.

Wildlife

The level of ungulate road collision mortality in the project area for Phase III is considerably less than that encountered to the east (Phases I and II). This is primarily due to the alignment of the existing highway through an area which avoids the known winter range west of Sunshine Road (Figure 3.6-1). Also, west of Castle Mountain Junction there is relatively little winter range. Elk sustain the highest mortality rate of ungulates followed by mule deer and moose. However, because of the small number of moose in the Park, they may be exposed to the greatest impact.

Direct mortality of other large mammals such as grizzly bears, black bears, wolves, lynx and wolverine may increase as a result of highway twinning. Grizzly bears could be a concern because even a small number of road kills could affect local populations. However the number of road kills for grizzly and black bears has declined since 1980 possibly because of improved garbage disposal in the Park.

It is not known, nor can it be reliably predicted, if the wild life collision mortality rate will increase or decrease as a result of the proposed Phase III improvements to the TCH. It is predicted that the proposed use of a wide forested median will reduce the road kill problem. Nevertheless it must be expected that a perceived concern for Phase III will be a possible increase in road mortality.

Fencing and underpasses are known to be effective in mitigating this type of mortality. The characteristics of Phase III, however, do not warrant implementation of the same program used in Phases I and II. As a result, a phased program of mitigation is proposed that involves additional research and analysis leading to final alignment selection, followed by detailed design on a section by section basis which will consider a program of limited fencing. Additional data are required from Phases I and II to define the most acceptable underpass type. To ensure effectiveness, this approach will also require a monitoring study of ungulate mortality rates on Phase III.

For the purposes of this Initial Assessment, it can be concluded that using a design which incorporates adequate mitigation measures and follow-up monitoring, the ungulate road mortality in Phase III can be kept to an acceptable level.

Other adverse impacts associated with Phase III include habitat loss for birds and mammals, disturbance and disruption of movements. These impacts are considered to be minor and can be offset by the mitigative approach proposed.

Land Use and Recreation

Parks Canada have reviewed the use and importance of the various recreational sites along the highway. As a result, access to all four trailheads will be maintained; the Castle Mountain viewpoint will be relocated and provided with two-way access; three picnic sites east of Castle Mountain Junction will be eliminated; and the Lake Louise overflow campground will be closed. Access to the Bow River for canoeists and kayakers will be provided at various points.

Land Use History and Archaeology

Twelve sites of interest have been identified in that portion of the project area east of Castle Mountain Junction (km 47). Four of these sites would probably be directly impacted by the project, and an additional two would be affected if the south alignment alternative is selected. A program for salvaging and further investigation of these sites is summarized in Table 5.8-1.

Field surveys of the route west of km 47 to Lake Louise is expected to identify further sites. The extent to which these sites will be affected will not be known until the detailed alignment has been chosen and the limits of the areas to be disturbed have been marked in the field.

Although the abundance of significant sites along the route is low it is expected that some of them may be of high heritage value. Of particular interest is the palaeontological site at km 43.2 which exhibits an excellent diversity and preservation of Triassic fish fossils.

A program designed to adequately investigate and salvage specimens and data from these sites will be pursued. Professional archaeologists and palaeontologists will be retained.

Visual Resource

Possibly one of the most significant benefits of the project is the opportunities that exist for wide separation of opposing lanes and curvilinear alignment. This would constitute a substantial improvement over present conditions, particularly west of Castle Mountain Interchange which suffers from lengthy straight tangents through monotonous lodgepole pine. Further, with east and westbound traffic separated, travellers will partake in greater visual enjoyment of the Park environment.

Other benefits include:

- A number of existing cuts which presently have visual impacts will be regraded and can therefore receive the benefits of a higher standard of rehabilitation. The northerly exposures and the cool wet climatic regime of the area will facilitate successful revegetation of disturbed areas.

- The alternative south alignment between km 28.5 and km 33, due to its higher location, would provide a more panoramic view of the valley, and also differing visual experiences for east and westbound travellers.

- If, to avoid excessive cuts the highway fills are permitted to further encroach upon the Bow River at km 51.5 and km 55.5, the present unnatural linear appearance of the river could be improved.

However, some large cuts will be unavoidable resulting in additional visual impact on the Park landscapes for several years. Some of the largest cuts would occur on the alternative south alignment between km 28.5 and km 33. The impact of these cuts would be greatest when viewed from the Bow Valley Parkway and railway.

The widened highway and cleared right-of-way will generally increase the visual impact when viewed from distant elevated points. The uniform consistent forest cover will exacerbate this impact.

Finally, where concrete barriers are unavoidable, the visual experience of most travellers will be impacted by the close proximity of the additional lanes and the barriers.

Socio-Economic and Tourism

The prime benefit upon completion of the improvements will be to the road user. Traffic congestion over the improved section of the highway will be substantially reduced. The change to a 4-lane limited access highway will result in unquantifiable changes to the experiences of park visitors. The resulting relief in traffic congestion will allow normal growth in the local recreation and touristrelated activities, while protecting the environment through appropriate mitigation.

During construction, disruption of traffic flow and the need for temporary detours, changes in speed limits and alignment will have adverse effects on travel times and visitor experience. However, because of the less restrictive nature of the right-of-way of the TCH from km 27 to km 75, it is anticipated that less interference will be experienced by the traffic than was experienced in Phases I and II. Nevertheless, as a result of this construction activity, some regional visitors may avoid short-term visits during high use periods and some out-of-region visitors may postpone return visits.

General contractors retained for each aspect the construction program will likely come from outside the project region, as local contractors do not have sufficient capacity equipment or manpower to undertake the construction tasks required. However spin-off work from the larger contracts will benefit local contractors. Also, an estimated $2.2 million will accrue indirectly to local residents employed on the project (out of a total $27.6 million project labour costs).

Construction camps will be used to house labourers. These camps will be developed in the context of current Parks Canada guidelines.

MODIFICATIONS TO ALIGNMENT

Three potential changes to the proposed alignment are being considered (refer to Figure 2.2-2):

a) Between km 28.5 and 33.0, a shift to the south by some 100 m and higher up the slope.

b) At km 51.5 and 55.5, the highway location is restricted between the Bow River to the north and steep hillsides to the south. The proposal calls for additional cut to avoid encroachment on the river. The alternative is to encroach on the river and avoid the cut; this may require some changes to the far (north) bank of the river.

c) Between km 47.0 and 69.0, the proposed alignment is a series of lengthy straight tangents running virtually parallel to the existing highway. The alternative (not shown on Figure 2.2-2) would comprise a substantial increase in the separation of the east and west lanes and a curvilinear alignment for the new lanes.

Table S-1 graphically compares the environmental impacts of these changes.

With respect to item a), there is no marked preference for either alternative. It appears to hinge on the actual magnitude of the cut slopes on the south route (which is not yet known) versus the improved views and driving experience.

With respect to item b), there is a very marked preference to encroach upon the Bow River. Not only does this avoid additional cuts, but it provides an opportunity to improve visually the present conditions and provide better fish habitat. The river at these locations presently has a straight unnatural appearance; the result of rechanneling for the existing highway. It is possible that an alignment closer to the river may affect unknown archaeological sites.

With respect to item c), the project provides an opportunity to considerably improve the driving experience and the views from the highway, west of Castle Mountain Junction. The present alignment comprising long straight sections through lodgepole pine tneds to be monotonous. Although little can be done about the existing lanes, the terrain allows considerable flexibility with respect to the location and design of the new lanes.

A more extensive (than item a) south alignment of the additional lanes, removed from the existing highway is possible. This alignment would further avoid the ungulate winter ranges east of Castle Mountain Junction, but at the probable expense of increased impact on terrain (cut slopes) and disturbance of Park land.

It is apparent that a comprehensive analysis of the Phase III alignment is required prior to final selection.

TABLE S-1 COMPARISON OF ENVIRONMENTAL IMPACTS OF ALTERNATIVE ALIGNMENTS

	RESOURCE PARAMETER	ALTERNATIVE ALIGNMENTS					
		Km 28.5 to Km 33.0		Km 51.5 and Km 55.5		Km 47.0 to Km 69.0	
		As proposed	South Route	Hillside Cut	River Encroached	As proposed	Widen Separation and Curvilinear
ENVIRONMENTAL QUALITY	Terrain	●	⬤	⬤			
	Stream Regime				○		
	Significant Vegetation	●	●			●	●
	Fish Habitat			⬤	○		
	Wildlife Mortality	⬤	●			⬤	●
	Wildlife Habitat					●	●
HUMAN ACTIVITY AND VALUES	Use of Park Facilities	●	⬤			⬤	⬤
	Disturbance of Park land	●	⬤	●	●	●	⬤
	Archaeological Sites	⬤	●		●	●	●
	Views from Highway		○	⬤	○	⬤	○
	Views of Highway	●	⬤	⬤		●	●
	Driving Experience	○	○			⬤	○

LEGEND: ○ Beneficial Impact; ⬤ Adverse Impact; The larger the circle, the greater the impact

CONCLUDING REMARKS

This Initial Assessment has been carried out in accordance with the Federal Environmental Assessment and Review Process. It covers the proposed four-laning of the TCH in Banff National Park from Sunshine Road (km 26) to the Jasper Highway (Icefields Parkway Interchange, km 75). These improvements constitute Phase III of the TCH four-laning program (Phases I and II are now virtually complete).

The Assessment concludes that:

a) The proposed improvements can be clearly justified from the standpoint of both accommodating present and predicted traffic volumes, and economic efficiency.

b) There are no viable alternatives to the proposed improvements that are environmentally superior.

c) With good design and construction procedures, mitigation and monitoring, there will be no significant environmental impacts resulting from the proposed improvements.

d) The management of the project (Phases I and II), including environmental management, and communications with the general public have been good. These management procedures will be maintained in Phase III.

e) There is no expectation that the level of public concern over the environmental aspects of Phase III will be significant.

f) Modifications of the preliminary layout of the proposed improvements as described in the Assessment, particularly with respect to alignment, will be considered prior to detailed design.

g) Selected additional environmental studies are required and these also are to be carried out prior to detailed design.

As a result of the conclusions of this Assessment, it is recommended that the proposed Phase III proceed without a formal public review.

1

Project Setting

SECTION 1.1

DECLARATION AND OBJECTIVES

Public Works Canada is the sponsor of this Initial Assessment and is responsible for its statements and judgments.

Address:

Public Works Canada,
Western Region
9925 - 109th Street
Box 488
Edmonton, Alberta
T5J 2K1

Public Works Canada is proposing to make further improvements to the TCH through Banff National Park. Phase III will extend from km 26 at Sunshine Road to km 75 at the Icefields Parkway Interchange (Hwy. 93). The improvements will comprise upgrading the existing highway to four traffic lanes.

This document has been compiled by specialists from the private and public sectors, (see References), and draws upon extensive information gained during preparation of Environmental Impact Statements for Phases I and II, as well as Public Hearings held prior to construction of these phases.* Experience gained during construction through monitoring by the Environmental Coordinator and staff of Public Works Canada and Parks Canada has also been considered.

The existing highway through Banff National Park is part of the TCH system which extends from St. John's, Newfoundland to Victoria, British Columbia. The TCH is Canada's main east-west transportation route and is the main access highway into Canada's mountain parks. It also connects with Highway 93 which leads to Jasper National Park to the north and Kootenay National Park to the south. West of Banff National Park, The TCH traverses Yoho, Glacier and Mt. Revelstoke National Parks in B.C. on route to the west coast.

Phase I and II commenced after reports (dated October, 1979 and April, 1982 respectively) from Environmental Assessment Panels recommended construction proceed. As of this date, Phase I is virtually complete and Phase II is scheduled for completion in 1986.

*Phase I covered the highway improvements extending from East Gate to km 13; Phase II covered the section from km 13 to Sunshine Road (km 27).

The objective of the proposed improvements is to provide a functional, efficient, safe and aesthetically pleasing highway which will meet present and future user demands and be environmentally acceptable. The study area covered in this Initial Assessment is shown in Figure 1.1-1. The improvements to the highway will result in a four lane limited access highway to RAD-100 standard. The work includes a revision to the Castle Mountain and Icefields Parkway interchanges, and also several new bridges; new major bridges will be required at km 69 over the Bow River and at km 70 (CPR Overpass).

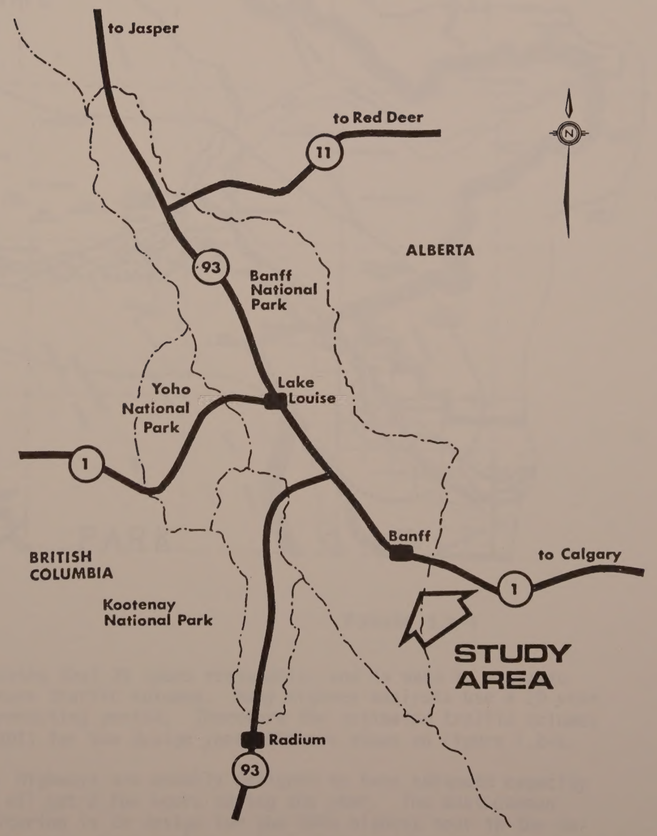


FIGURE 1.1-1

SECTION 1.2

THE NEED

The Trans Canada Highway (TCH) is Canada's only truly national highway; it passes through all ten provinces and carries heavy interprovincial traffic. This section covers the justification or need for further improvements to the highway west of Sunshine Road (the termination of Phase II) on to Lake Louise. The results of several traffic and economic studies are summarized. These studies were designed to establish current traffic conditions, to forecast likely future conditions, and to determine economic viability. The information used is common in many respects with that used for Phases I and II.

1.2.1 BACKGROUND AND STUDY AREA

Although an environmentally protected area, the mountain park system constitutes a premiere Canadian tourist attraction. These parks are heavily advertised, known world wide and accommodate the largest number of visitations of any of the National Parks. Banff National Park presently accommodates close to three million visitors annually.

The TCH is located within the major trans-mountain transportation corridor through the Park. This portion of the Park is highly accessible and this accessibility has no doubt contributed to its great popularity.

The proximity of the City of Calgary contributes to year-round demand. Accommodations and facilities are heavily utilized in summer by tourists and in winter by skiers. Additional attractions in British Columbia generate traffic through the Park by residents of Alberta wishing to travel to these facilities via surface transportation.

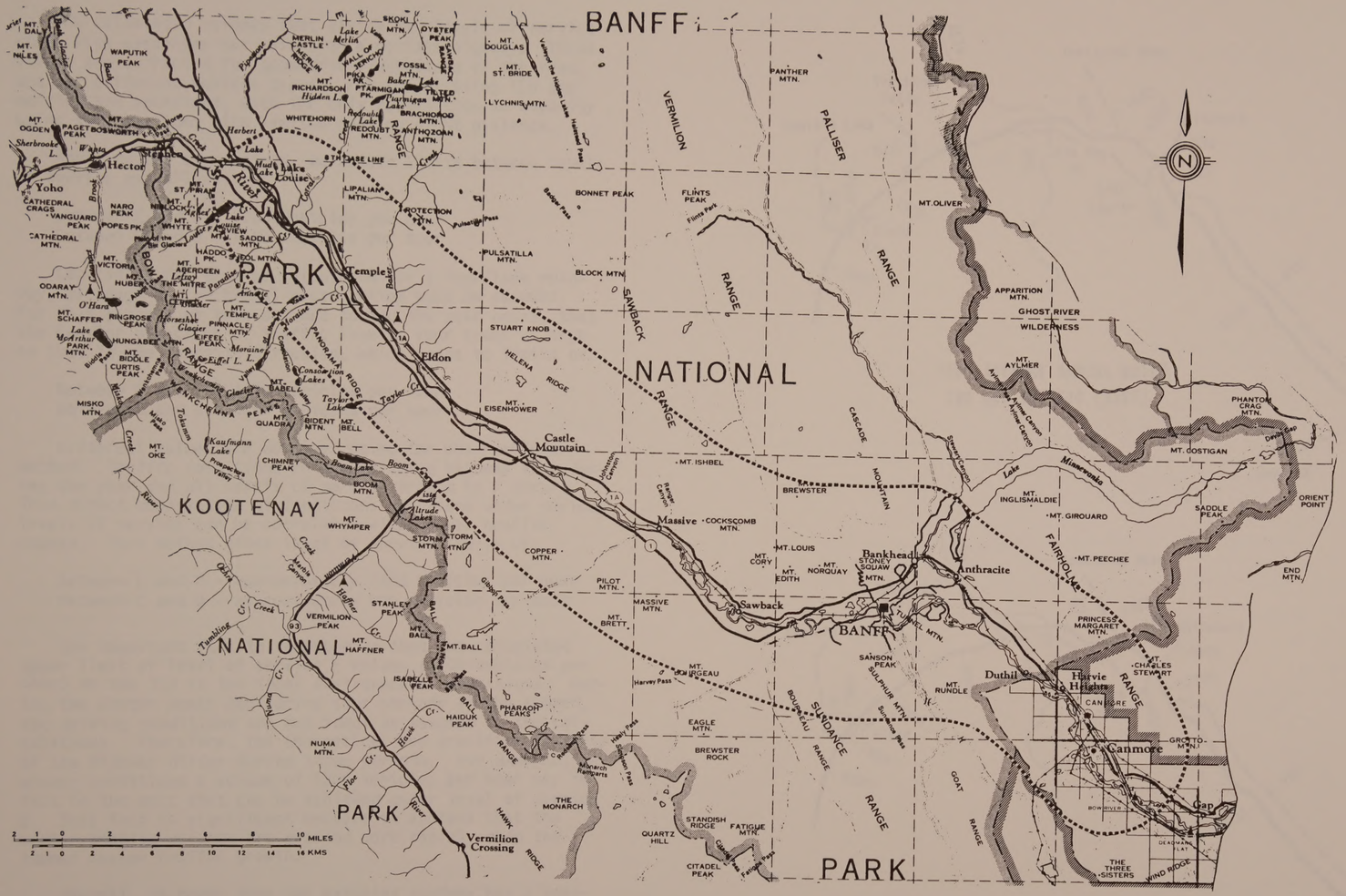
The primary mode of travel for visitors and through traffic is the automobile. The peak traffic periods have generated sufficiently high vehicular volumes to overtax the available capacity of the existing roadway system. Other adverse impacts are also evident, namely increased accident potential and increased road user costs for visitors and through-traffic alike.

The study area for this analysis (Figure 1.2-1) extends beyond the geographic boundaries of the Phase III improvements in order to provide a comprehensive picture.

1.2.2 EXISTING AND FUTURE TRAFFIC CONDITIONS

Traffic counts along the TCH have been conducted annually by Parks Canada for many years. These counts have been supplemented by counts by Public Works Canada, the University of Calgary and the Alberta Department of Transportation.

Most analyses require traffic counts in either annual or


BANFF
NATIONAL
PARK
KOOTENAY
PARK
Eldon
Temple
Castle Mountain
Massive
Sawback
Bankhead
Anthracite
BANFF
Canmore
Harvie Heights
Dunthil
Gap
Vermilion Crossing
Mistaya Lake
Lake Louise
Hector
Yoho
Field
Golden
Boom Lake
Altrude Lakes
Consolation Lakes
Taylor Lake
Kaufmann Lake
Herbert Lake
Hidden L.
Redoubt Lake
Baker Lake
Wapta Lake
Emerald Lake
Moraine Lake
Lake Louise
Lake Minnewanka
Vermilion Lakes
Bow River
Kicking Horse River
Vermilion River
Simpson River
Spray River
Cascade River
Panther River
Pipestone River
Bow Glacier
Wapta Glacier
Waputik Icefield
Wenkchemna Glacier
Victoria Glacier
Lefroy Glacier
Deville Glacier
Boom Glacier
Redoubt Glacier
Pipestone Glacier
Mt. Douglas
Mt. St. Bride
Lychnis Mtn.
Panther Mtn.
Mt. Oliver
Mt. Aylmer
Ghost River Wilderness
Phantom Crag Mtn.
Mt. Gostigan
Mt. Inglismaldie
Mt. Girouard
Mt. Peechee
Saddle Peak
Orient Point
End Mtn.
Princess Margaret Mtn.
Charles Stewart
Mt. Rundle
Sanson Peak
Sulphur Mtn.
Mt. Norquay
Mt. Cory
Mt. Edith
Mt. Louis
Cockscomb Mtn.
Mt. Ishbel
Brewster
Mt. Eisenhower
Mt. Bell
Mt. Babel
Mt. Quadra
Mt. Biddle
Mt. Victoria
Mt. Temple
Mt. Whymper
Mt. Haffner
Mt. Ball
Mt. Brett
Mt. Bourgeau
Mt. Oke
Mt. Richardson
Mt. Ogden
Mt. Niles
Mt. Dal
Mt. Whyte
Mt. Hubert
Mt. Aberdeen
Mt. Schaffer
Mt. Hungabee
Mt. Lefroy
Mt. Deltaform
Mt. Goodsir
Mt. Collier
Mt. Balfour
Mt. Lipalian
Mt. Douglas
Mt. Bridge
Mt. Fossil
Mt. Ptarmigan
Mt. Tilted
Mt. Brachiopod
Mt. Anthozoan
Mt. Redoubt
Mt. Saddle
Mt. Pulsatilla
Mt. Protection
Mt. Stuart Knob
Mt. Helena Ridge
Mt. Isabelle Peak
Mt. Haiduk Peak
Mt. Pharaoh Peaks
Mt. Numa
Mt. Eagle
Mt. Brewster Rock
Mt. Standish Ridge
Mt. Fatigue
Mt. Quartz Hill
Mt. Citadel Peak
Mt. The Monarch
Mt. Three Sisters
Mt. Wind Ridge
Mt. Deadman Flat
Mt. Stoney Squaw Mtn.
Mt. Vermilion Peak
Mt. Stanley Peak
Mt. Misko
Mt. Odaray
Mt. Cathedral
Mt. Vanguard
Mt. Narao Peak
Mt. Popes Pk.
Mt. Whitehorn
Mt. Merlin Ridge
Mt. Wall of Jericho
Mt. Oyster Peak
Mt. Fossil
Mt. Ptarmigan Pk.
Mt. Tilted
Mt. Brachiopod
Mt. Anthozoan
Mt. Redoubt
Mt. Lipalian
Mt. Protection
Mt. Pulsatilla
Mt. Block
Mt. Whyte
Mt. Saddle
Mt. Haddo Pk.
Mt. Stool
Mt. Victoria
Mt. Aberdeen
Mt. Temple
Mt. Pinnacle
Mt. Biddle
Mt. Curtis Peak
Mt. Babel
Mt. Quadra
Mt. Bell
Mt. Ident
Mt. Chimney Peak
Mt. Boom
Mt. Whymper
Storm Mtn.
Copper Mtn.
Pilot Mtn.
Massive Mtn.
Mt. Brett
Mt. Ball
Mt. Haffner
Vermilion Peak
Stanley Peak
Isabelle Peak
Haiduk Peak
Pharaoh Peaks
Numa Mtn.
Eagle Mtn.
Brewster Rock
Standish Ridge
Fatigue Mtn.
Quartz Hill
Citadel Peak
The Monarch
Three Sisters
Wind Ridge
Deadman Flat
Mt. Bourgeau
Mt. Sulphur Mtn.
Sanson Peak
Mt. Rundle
Mt. Norquay
Mt. Cory
Mt. Edith
Mt. Louis
Mt. Ishbel

The calculated volumes that divide the levels of service start with passenger car values on a perfect highway. These values are corrected for geometric limitations of the road, and for different vehicle types. For the existing TCH geometrics are excellent, with the only restriction to capacity being some sections with limited passing sight distance.

Applying the corrections, we obtain limits between levels of service as follows:

Between E and F - 1700 vehicles per hour
Between C and D - 1140 vehicles per hour

Capacities can also be calculated for a four lane roadway, although a directional distribution must be assumed. For this purpose we have assumed during the peak hours, that the heavier direction of traffic flow is four times as high as that in the opposite direction, which leads to limits of:

Between E and F - 4350 vehicles per hour
Between C and D - 3260 vehicles per hour

Different values are obtained using the observational method. Traffic conditions on the existing highway vary during the year and all levels of service from A to F occur. Thus direct observation of conditions described under various levels of service can be correlated with actual traffic counts. This method gives level of service limits of:

Between E and F - approximately 1500 vehicles per hour
Between C and D - approximately 900 vehicles per hour

One important fact to remember is that the calculated upper limit of level of service E volume (1700 vehicles per hour) on the TCH is for ideal environmental conditions. During the winter peaks and during some periods in the summer, the driving conditions are not ideal as assumed in the calculations. Therefore, the theoretical and practical capacity of the highway differ during these periods. For example, in winter conditions a volume of 1300 vehicles per hour may in fact be the most that can be achieved under level of service E. This fact is significant because it appears that the winter traffic volumes are growing more rapidly than the summer season traffic growth.

Overall, it seems that the existing roadway has a possible capacity of about 1500 vehicles per hour (the limit between levels of service E and F). However, using the more desirable criteria whereby no more than 30 hours per year exceed level of service C (900 vehicles per hour), traffic volumes exceeded the criteria years ago from Sunshine to Castle Mountain Junction section. From Castle Mountain Junction to Lake Louise, traffic volumes have exceeded the criteria since about 1978, and it is expected that the criteria will be exceeded in 1985 on the section of highway between Lake Louise and the Icefields Parkway.

The more critical "possible" capacity condition occurs now a few hours per year between Sunshine and Castle Mountain Junction. This condition would grow to about 500 hours by the year 2005. The other sections will be congested less,

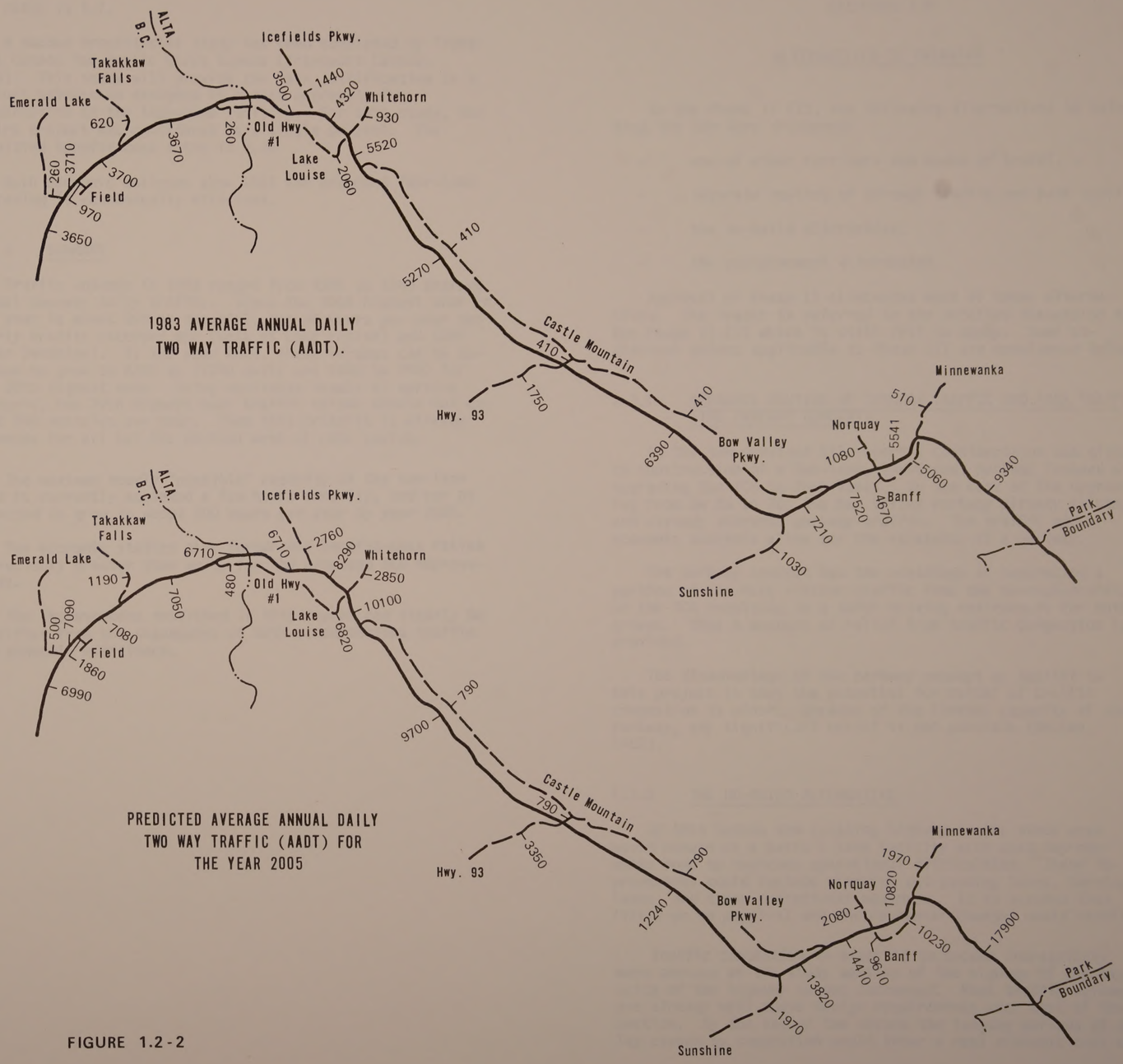


FIGURE 1.2-2

but even Lake Louise to Icefields Parkway will exceed "possible" capacity conditions for an estimated 10 hours per year by year 2005. Clearly, roadway capacity has been less than desirable for some time, and will become more and more intolerable in the near future.

A four lane roadway will operate with desirable levels of service (A, B, and C) when hourly two-way volumes are less than 3260. The section with the highest traffic volume expected in year 2005 will have a 30th hour of 2450. A four lane highway should not exhibit any noticeable congestion for at least 30 years.

While not part of this Initial Assessment, the TCH west of the Icefields Parkway Interchange is estimated to reach the 30th highest hour limit (900 vehicles per hour) in or around 1990.

1.2.4 ECONOMIC ANALYSIS

While expenditures on transportation facilities occur for a variety of reasons, the most defensible reason is to improve economic efficiency. One way of looking at efficiency is to examine the extent to which the expenditure of public funds leads to an increase in the real per capita gross national product.

In the case of government expenditures on roadway projects, the expenditure is said to be efficient if the cost is less than the resulting savings in resource utilization associated with maintenance and road user operation. These savings are assumed to be available for other uses that will increase the gross national product.

The determination of whether or not a proposed investment will result in increased efficiency is the role of economic analysis. Among the analytical techniques used is the benefit-cost ratio . Calculations are made of savings resulting from construction of a project, and of the costs of the project. The savings (benefits) are divided by the costs, and where the resulting benefit-cost ratio is greater than unity, there is economic justification for the project.

In the case of the proposed project two benefit-cost studies have recently been completed. One of these was instigated by a recommendation of the E.A.R.P. Panel studying the Phase I upgrading of the TCH. Transport Canada commissioned N.D. Lea and Associates for this study (Lea 1985). The results are as follows:

- For the section of highway between Sunshine Road (approx.) and Castle Mountain Interchange, the benefit-cost ratio is 2.7.

- For the section of highway between Castle Mountain Junction and the Bow River Bridge (near Lake Louise), the benefit cost ratio is 1.3.

- For the section of highway between the Bow River Bridge and the Icefields Parkway Interchange the benefit cost ratio is 1.7.

A second benefit-cost study has been completed by Transport Canada for Public Works Canada (Transport Canada, 1985). This study will provide the main justification in a cabinet submission designed to obtain approvals for construction of the four-lane facility. For this study, the entire project was considered as a single project. The resulting benefit-cost ratio is 2.35.

Both economic analyses show that the proposed four-lane upgrading is economically efficient.

1.2.5 SUMMARY

Traffic volumes in 1983 ranged from 4320 to 6390 average annual two-way daily traffic. Since the 30th highest hour in the year is about 20% of the AADT, for 30 hours per year the hourly traffic exceeded 860 (west of Lake Louise) and 1280 (near Sunshine). By the year 2005, these volumes can be expected to grow to 8290 to 12240 daily and 1660 to 2450 for the 30th highest hour. Using desirable levels of service criteria, the 30th highest hour traffic volume should not exceed 900 vehicles per hour. Thus this criteria is already exceeded for all but the section west of Lake Louise.

The maximum hourly "possible" capacity of the two-lane road is currently exceeded a few hours annually, and can be expected to grow to about 500 hours per year by year 2005.

Two economic studies give favourable benefit-cost ratios appreciably greater than unity for the proposed TCH improvements.

The improvements described in this report can clearly be justified from the standpoint of both accommodating traffic and economic efficiency.

SECTION 1.3

ALTERNATIVES TO TWINNING

In the Phase II EIS, the following alternatives to twinning the TCH were discussed:

- use of other corridors and modes of travel;
- separate routing of through traffic and Park traffic;
- the no-build alternative;
- the postponement alternative.

Approval of Phase II eliminated most of these alternatives. The reader is referred to the detailed discussion in the Phase II EIS which is still felt to apply. Some additional points applicable to Phase III are considered below:

1.3.1 SEPARATE ROUTING OF THROUGH TRAFFIC AND PARK TRAFFIC (THE PARKWAY CONCEPT)

In the two previous EIS reports, consideration was given to construction of a two-lane, low-speed, parkway instead of upgrading the TCH to four lanes. In the case of the upgrading from km 26 to 70, the Bow Valley Parkway already exists, and already attracts parkway traffic. The traffic and economic analysis allow for the existence of a parkway.

The parkway concept has the advantage of separating a portion of the Park visitor traffic from the through-traffic on the TCH resulting in a safer driving environment for both groups. Thus a measure of relief from traffic congestion is provided.

The disadvantage of the parkway concept as applied to this project is that the potential for relief of traffic congestion is minor. Because of the limited capacity of the Parkway, any significant relief is not possible (DeLCan, 1982).

1.3.2 THE NO-BUILD ALTERNATIVE

In this option the existing highway in the study area would remain as a basic 2 lane facility with spot improvements made to overcome operational difficulties. These improvements could include climbing and passing lanes, turning lanes, and other operational measures. It is assumed that little or no physical and environmental changes would result.

Traffic congestion is expected to become increasingly more serious on the study section of the highway if the capacity of the highway is not increased. Peak traffic volumes are already well above design requirements over most of the section. By the end of the decade the lengthy periods of delay caused by congestion would incur a real economic cost on

commercial traffic and business travellers, and an indirect cost on all other travellers. The efficiency of emergency vehicle operations would also be affected.

The most noticeable impact would be felt by the Park visitor. Progressively increasing congestion of traffic for several hours at a time would cause the highway to take on the appearance of a rush hour urban roadway, not appropriate in a National Park or on Canada's major east-west highway.

2

Description of Proposed Project

SECTION 2.1

EXISTING HIGHWAY CONDITIONS

2.1.1 DEVELOPMENT OF THE EXISTING HIGHWAY

The first access road from Calgary to Banff suitable for automobiles was constructed in 1911. This initial road within the Park was upgraded and paved in the early 1930's. By the late 1940's traffic volumes were such that relocation and reconstruction to a rural two-lane highway standard was required. In 1952, work commenced on these improvements starting at the East Gate. By 1954, with the advent of the Trans Canada Highway (TCH) Agreement, new standards were applied; the 4 mile section commenced in 1952 was re-done and the prevailing standard was carried through to the existing traffic circle at Banff by 1956, and to Eisenhower Junction in 1959. The entire route of the TCH across Canada was officially opened in 1962.

More recently, the present 4 lane divided facility between the East Park boundary and Calgary was commenced by Alberta Transportation in 1966 and completed in 1971.

2.1.2 DESCRIPTION OF THE EXISTING HIGHWAY

The existing highway between kilometres 27 and 75 is a rural paved two-lane undivided highway with a design speed of 110 km/hr and posted speeds of 90 and 70 km/hr. The total width of the pavement is 13.4 m comprised of two driving lanes each 3.7 m wide and paved shoulders each 3.0 m wide. The width of the right-of-way is 61 m. Structurally, the highway is continuing to perform well. There is no evidence of the rutting, warping, alligator cracking or pot holing that might be expected with a 20 year old facility. The most noticeable defects are cold temperature transverse shrinkage cracks, which are a common problem encountered in most older pavements in Canada.

A typical cross section of the existing highway is shown on Figure 2.1-1.

A visual appreciation of the highway and the terrain it crosses is provided by the topographic plan in Figure 2.1-1 and the display of oblique aerial photographs in Fig. 2.1-2.

The present alignment follows the south side of the Bow River Valley for the entire route between the Sunshine Road and the Icefields Parkway. After a directional change at km 27.7 the overall direction is consistently northwest-southeast. The alignment location is frequently limited by the close proximity of the steep hillsides to the south and the river to the north. Grades on this section of the TCH are modest, ranging up to 3%.

Rock cuts are few. At km 26.6 the road cuts into steeply dipping limestone. The direction of dip is southwesterly and favourable to slope stability. At km 44.5, additional limestone cuts occur, but with beds dipping adversely towards the highway. The last major rock cut area occurs in slates at km 74.7

Culvert sizes range from 600 mm to 3670 mm. Most of them are either 800 mm or 900 mm. Further information on drainage structures can be found in Section 3.2.

Landmarks and prominent features along the route are identified on Figure 2.1-1 and are listed below:

- Road junction serving Sunshine Ski Area (km 26.0)
- Castle Mountain Viewpoint (km 38.1)
- Junction with Hwy 93 to Kootenay National Park (Castle Mountain Interchange) (km 47.1)
- Bow River Viewpoint (km 64.3)
- Lake Louise overflow campground (km 66.6)
- Whitehorn Interchange, under construction (km 71.1 - 73.5)
- Icefields Parkway Interchange; junction with Hwy 93 to Jasper (km 75)

In addition to the above, there are six picnic sites located at kms 29.6, 37.3, 44.9, 46.8, 55.2, and 64.3.

There are seven bridges, other than interchange structures:

- Wolverine Creek Bridge (km 29.6)
- Redearth Creek Bridge (km 37.4)
- Altrude Creek Bridge (km 46.8)
- Moraine Creek Bridge (km 64.2)
- Bow River Bridge (km 69.4)
- CPR Overpass (km 69.7)
- Pipestone River Bridge (km 72.9)

SECTION 2.2

PROPOSED IMPROVEMENTS

The objective of the proposed improvements to the Trans Canada Highway is to alleviate the growing congestion and improve the safety of the facility, incorporating good engineering practice and sensitive environmental design. The proposed road would be a four lane divided highway with a design speed of 100 km/hr and a posted speed of 90 km/hr. The overriding concern in the preparation of this proposal is to minimize possible adverse environmental effects. Roadway cross sections consistent with highway safety are proposed and the new roadway would be carefully fitted to existing topography. The roadway design would be based on accepted standards published by the Roads and Transporation Association of Canada.

2.2.1 CROSS SECTION ELEMENTS

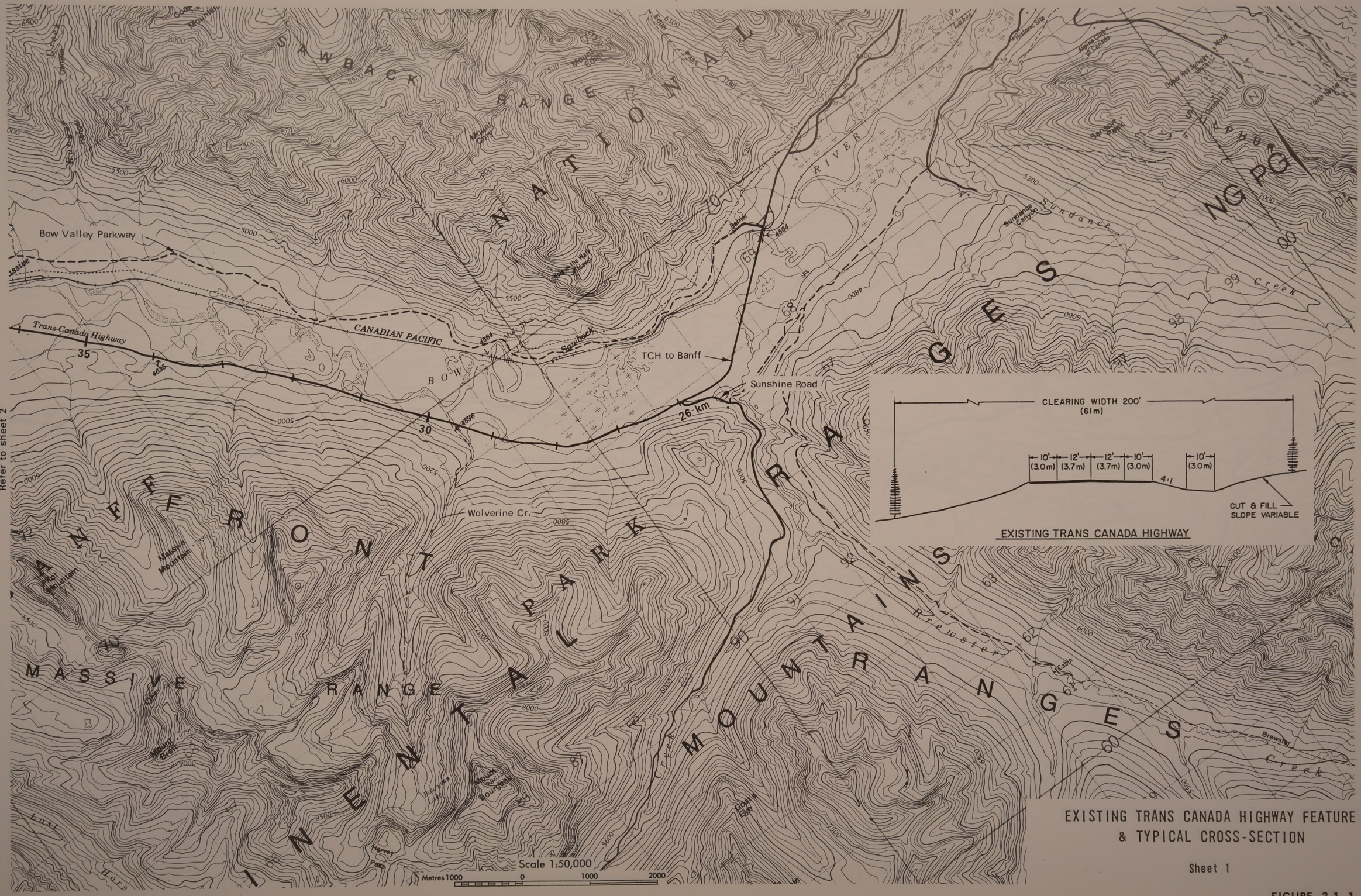
The cross section of the proposed four lane highway would consist of the existing pavement where possible (two lanes, two shoulders) plus two additional 3.75 m driving lanes, a 3.0 m outside shoulder and a 1.5 m inside shoulder. The lanes would be separated by a grassed median (cross section Type A), or a treed area (cross section Type B), or a concrete barrier (cross section Type C or Type D). Typical sections are shown on Figure 2.2-1.

Of the cross sections portrayed, Type B and secondly Type A are preferred and would be used wherever possible for the following reasons:

- The design is aesthetically more pleasing for a rural situation.
- It is safer, in that the driver has more room to manoeuvre; headlight glare is reduced; and, during winter, the road would be easier to maintain.
- Interference with existing traffic would be minimal during construction.
- Winter maintenance can be carried out using standard equipment and wide medians provide a substantial area for snow storage.

The disadvantages of Type C or D cross sections are:

- During construction there would be greater interference with traffic using the highway.
- The raised barrier increases noise levels and requires more attention by the driver tending to increase driver tension.
- Headlight glare can be greater.
- A positive drainage system, i.e. catch basins, leads,

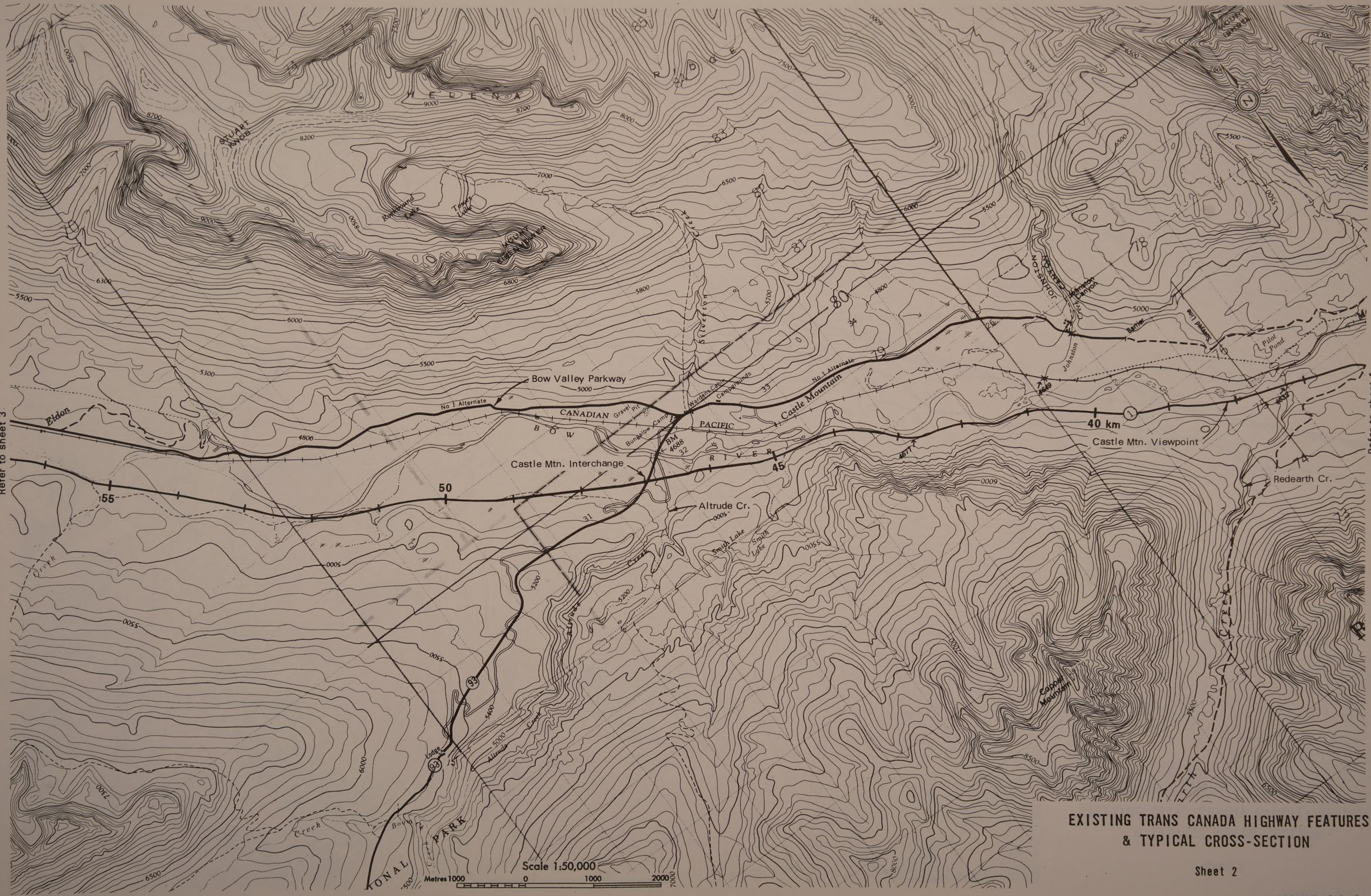


EXISTING TRANS CANADA HIGHWAY

EXISTING TRANS CANADA HIGHWAY FEATURE & TYPICAL CROSS-SECTION

Sheet 1

FIGURE 2.1-1



EXISTING TRANS CANADA HIGHWAY FEATURES
& TYPICAL CROSS-SECTION

Sheet 2

FIGURE 2.1-1

Pipestone River

Icefield Parkway Interchange

TCH to Golden

Whitehorn Interchange under construction km 71.1 to km 73.5

CPR Bridge

Bow River Bridge

Lake Louise Overflow Campsite

Bow Valley Parkway

Trans-Canada Highway

Bow River Viewpoint

CANADIAN PACIFIC RIVER

60 km

Moraine Cr.

Lake Louise Townsite

Lake Louise

PARADISE VALLEY

VALLEY OF THE TEN PEAKS

MORAINE LAKE ROAD

CONSOLATION VALLEY

PANORAMA RIDGE

Mount Temple 11000

Mount Aberdeen 10340

Mount Fairview 9001

Mount St. Piran

Mount Whyte

Mount Niblock 10073

Saddle Mountain

Sheol Mountain

Peak of the Six Glaciers

Scale 1:50,000

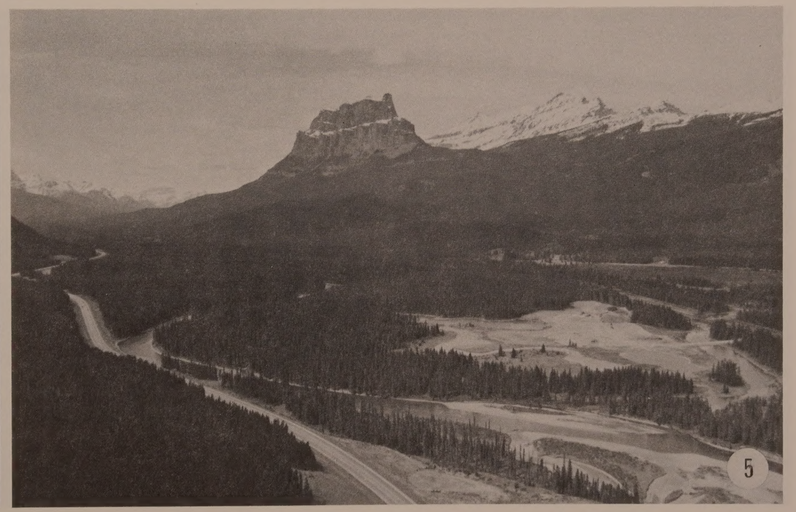
Metres 1000 0 1000 2000

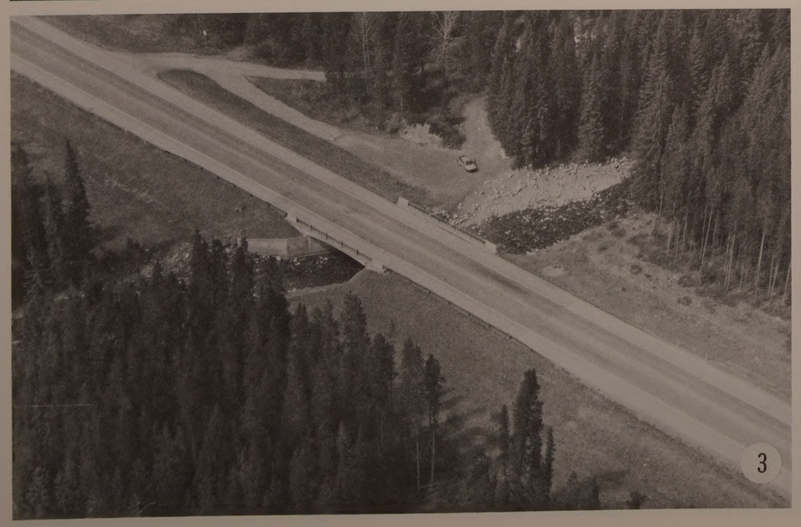
Refer to sheet 2

EXISTING TRANS CANADA HIGHWAY FEATURES & TYPICAL CROSS-SECTION

Sheet 3

FIGURE 2.1-1





(1) Phase II construction is underway to Sunshine Road (km 26); the interchange is still to be completed. The Bow River Valley extending west and Massive Mountain (peaking at elev 2437 m) form the background.

(2) Looking west from km 26. The bottom of the Bow River Valley is 1500 to 2000 m wide. The linear routing of the CP railway with the Bow Valley Parkway beyond is visible to the right (north). The river crosses the valley over to the south side after flowing through the slough and remains on that side to the Castle Mountain Interchange (km 47). Castle Mountain is just visible in the background.

(3) Redearth Creek bridge at km 37.3. This creek is the largest tributary stream in the study area, with a drainage area of 147 km^2. Unlike many streams in the area, this creek is boulder paved and stable at the highway.

(4) The Castle Mountain Viewpoint (km 38.1) on the north side of the highway is shown in the foreground with the river flowing adjacent to it. This viewpoint is to be relocated to km 38.9 (the first road bend to the west).

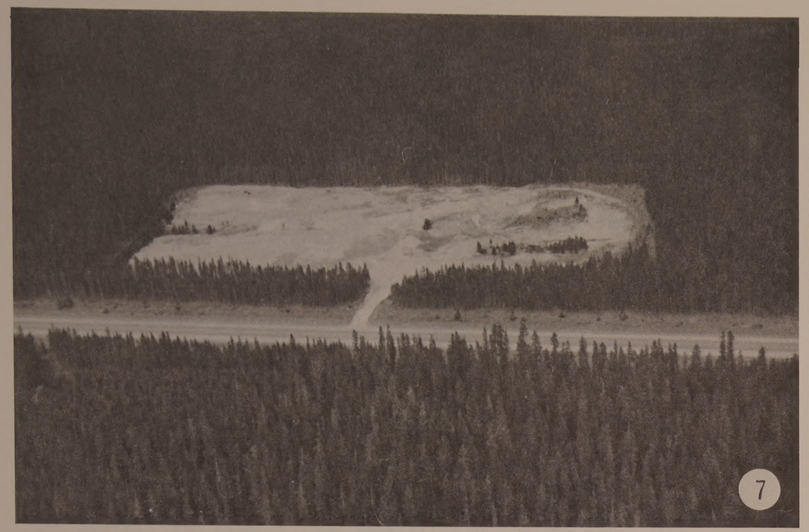
(5) Castle Mountain as viewed from km 41. The mountain extends up to Eisenhower Peak over 1200 m above the valley floor, and dominates the landscape. The Bow Valley Parkway on the right side of the photograph is clearly visible.

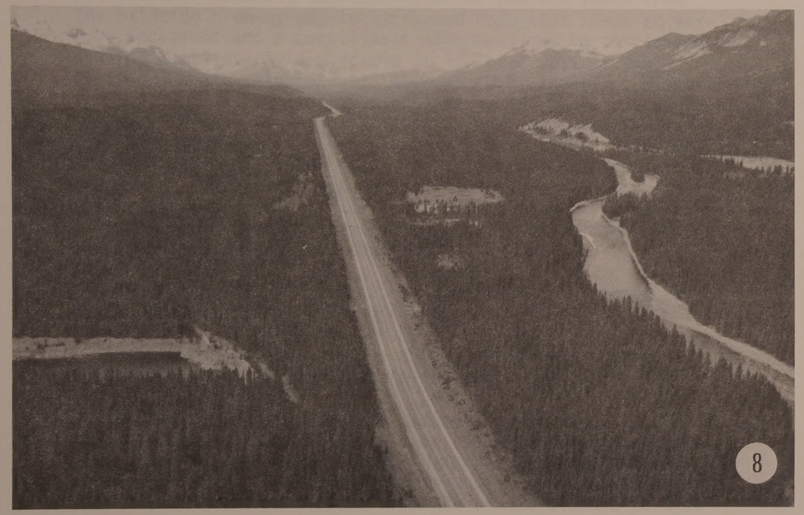
(6) The existing Castle Mountain Interchange at km 47 looking along the highway towards the west. Highway 93 south to Kootenay National Park takes off to the left. Altrude Creek, the second biggest tributary stream, flows to the right through a single span structure under the highway. This interchange will be reconstructed.

PHOTOGRAPHS

Sheet 1

FIGURE 2.1-2





(7) A former borrow area at km 50. Like this one, several areas west of Castle Mountain Junction have not been rehabilitated. Although shielded from the highway by a buffer of trees, their regular unnatural appearance is visible from higher elevations. A rehabilitated borrow area is just visible in the foreground on the left side of the photograph.

(8) Lengthy straight sections of highway through uniform lodgepole pine typify the study area west of Castle Mountain Junction. This photograph was taken at km 52.3 looking west.

(9) The highway is restricted at several locations by steep hillsides to the south (left) and the Bow River to the north. This photograph taken at km 55 shows how the river has been artificially straightened to accommodate the highway.

(10) The existing Bow River Bridge (km 69.3) and the CP Rail bridge crossing beyond; looking west.

(11) The Pipestone River crossing at km 73. A new bridge is under construction for the two additional lanes which form part of the Whitehorn Interchange development at Lake Louise.

(12) The Icefields Parkway (Jasper Highway) Interchange at km 75. This interchange marks the end of Phase III.

PHOTOGRAPHS

Sheet 2

FIGURE 2.1-2

etc., would be required in the median and maintenance would be more difficult.

- Increases snow drift accumulation, and snow clearing would be more difficult.

- A hazard to wildlife crossing if the area is not fenced.

Although preference will be given to wide medians, in areas where available space for the highway is limited the Type C or Type D cross sections are often unavoidable.

2.2.2 ALIGNMENT AND GRADE

A preliminary layout is shown on Figure 2.2-2.* The layout has been prepared for the purpose of this Initial Assessment only. The location of the alignment can be readily adjusted. For example, the separation of the new lanes from the existing highway may be increased from that shown at various locations and a curvilinear alignment may be introduced; this is particularly applicable to the area west of the Castle Mountain Interchange. Also at those locations where the alignment is limited by high land to the south and the Bow River to the north, a decision is to be made on the extent of cut versus fill encroachment on the river. For the proposal shown on Figure 2.2.2 the extent of the barrier sections and significant cuts and fills is summarized in Tables 2.2-1 and 2.2-2. The section from km 71.1 to km 73.5 (the Whitehorn Interchange development) is under construction and is not part of this assessment.

Between km 28.5 and km 33, an alternative alignment to that described below is being considered. This alignment (Figure 2.2-2 Sh 1) is located 50 to 100 m south of the present highway and higher up the slope. Other more extensive alignments over the hillsides to the south are possible.

At the junction of the TCH and Highway 93 (km 47), the Castle Mountain Interchange will be reconstructed to a modified diamond interchange, on the same basic alignment as the existing roadway. This proposal is shown on Figure 2.2-2, Sheet 6. The design differs from the simple diamond in that it provides a separate right turn ramp for the major turning movement (south to east). The eastbound and westbound lanes and two ramps of the interchange will cross Altrude Creek (km 46.8). Corrugated steel culverts are presently assumed for this crossing. The small single span bridge which presently carries the TCH over Altrude Creek would be demolished. There is currently a picnic site access from the TCH just east of Altrude Creek. The access to the TCH would be deleted and the access from Highway 93 would be improved.

A major crossing of the Bow River and the CP Rail tracks occurs at km 69.4 and km 69.7.

A preliminary layout for the section between km 73.5 and km 75 has not been completed however, a Type A cross section would probably be used to the proximity of the Icefields Parkway Interchange where the lanes would merge.

The Icefields Parkway Interchange will be modified or redesigned depending on further evaluation of the traffic volumes on the TCH and the Jasper Highway.

* This proposal is based on detailed ortho photo mosaics at a scale of 1 inch to 100 feet with two foot contour intervals. The information from these mosaics was digitalized and converted to a metric scale of 1:2000 with 1.0 metre contour intervals. The data was then utilized to generate a horizontal and vertical alignment for the new lanes with the area of the corridor study.

TABLE 2.2-1: LANE SEPARATION

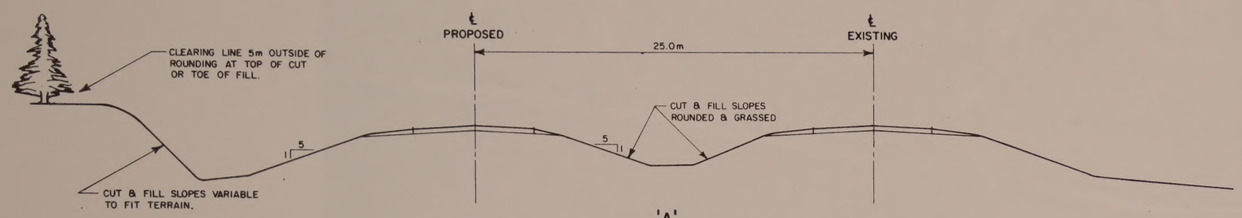
	KILOMETRE	LENGTH	REMARKS
TYPE A Minimum Depressed Grassed Median	26.5-29.8	3.3	-
	31.0-33.5	2.5	-
	37.5-39.7	1.9	-
	41.0-43.5	2.5	-
	44.7-48.8	4.1	Castle Mtn. Interchange
	56.0-57.6	1.6	-
	62.4-63.2	0.8	-
	73.5-75.0	1.5	-
	Total	18.2	
TYPE B Wide Treed Median	33.5-37.5	4.0	-
	39.4-41.0	1.6	-
			Castle Mtn. Interchange
	48.8-51.0	2.2	-
	51.9-55.1	3.2	-
	58.6-60.7	2 1	-
	63.2-65.2	2.0	-
	65.5-69.0	3.5	-
	Total	18.6	
TYPE C OR D Concrete Barrier	29.8-31.0	1.2	-
	43.5-44.6	1.1	-
			Castle Mtn. Interchange
	51.0-51.9	0.9	Can eliminate if alignment allowed to encroach into the Bow River.
	55.1-56.0	0.9	Possible raised barrier separation.
	57.6-58.6	1.0	-
	60.7-62.4	1.7	Possible areas of raised barrier separation.
	65.2-65.5	0.3	-
	Total	7.1	

TABLE 2.2-2: POTENTIAL CUTS AND FILLS

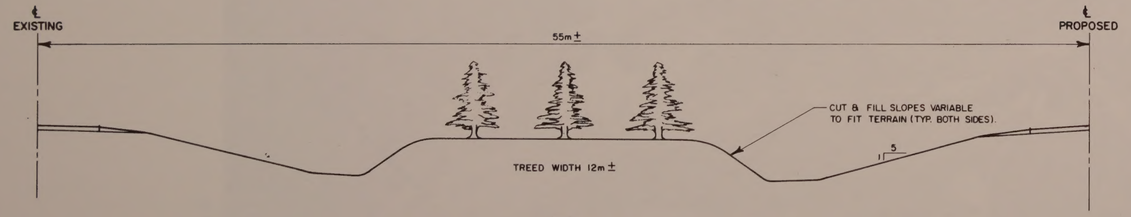
	KILOMETRE	HEIGHT[1]	SLOPES[2]
CUTS	30.2-31.6	0 - 47	Maximum backslope cut at km 30.9 using 2.5:1 backslope and type C median
	31.7-32.2	6 - 13	Backslope cuts using 2.5:1
	37.5-37.7	5 - 10	Backslope at 1:1
	38.7-39.3	0 - 80	Backslope at 1.7:1, maximum in area of km 39.1 using type A median.
	40.0-40.4	2 - 8	Full cut for westbound lanes
	41.0-41.2	0 - 12	Backslope at 2.5:1
	44.5-44.7	0 - 28	Backslope at 2.5:1 and type C median.
	52.0	30	Backslope at 1.7:1
	55.5-55.8	0 - 34	Backslope at 1.5:1
	56.5-56.8	16 - 36	Backslope at 2:1
	65.3-65.6	3 - 16	Backslope at 2.5:1
	67.7-67.9	4 - 8	Backslope at 2.5:1
FILLS	28.1-28.7	5 - 9	Sideslope at 1.3:1 to 3:1
	29.4-29.7	2 - 5	Sideslope at 2.5:1
	37.5-37.8	2 - 6	Sideslope at 3:1
	39.5-40.0	0 - 7	Sideslope at 3:1
	41.1-41.4	0 - 7	Sideslope at 3:1
	46.3-46.5	0 - 8	Sideslope at 5:1
	69.3-69.9	3 - 7	Sideslope at 5:1

1 Cut or fill height is the vertical distance (in metres) from top of cut to ditch bottom, or from the shoulder elevation to bottom of fill.

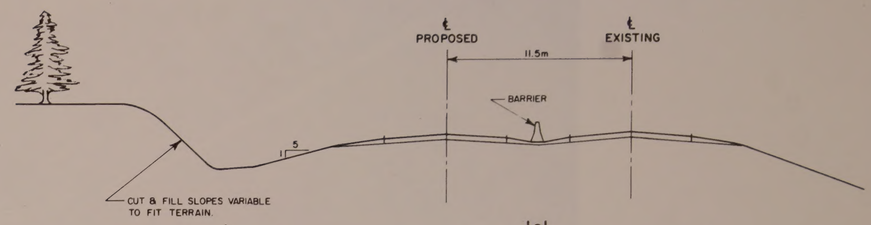
2 The indicated slopes are derived from preliminary design and will not necessarily be applied to final design.



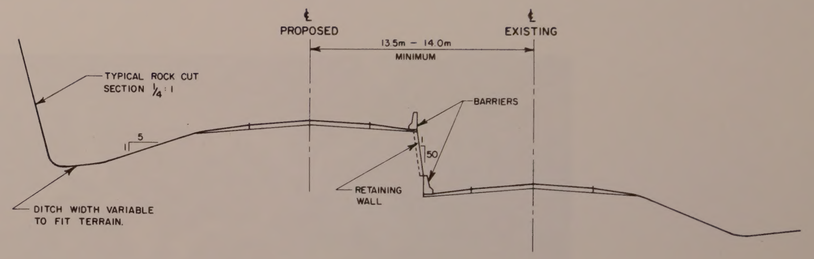
'A'
MINIMUM DEPRESSED MEDIAN
N.T.S.



'B'
WIDE MEDIAN
N.T.S.



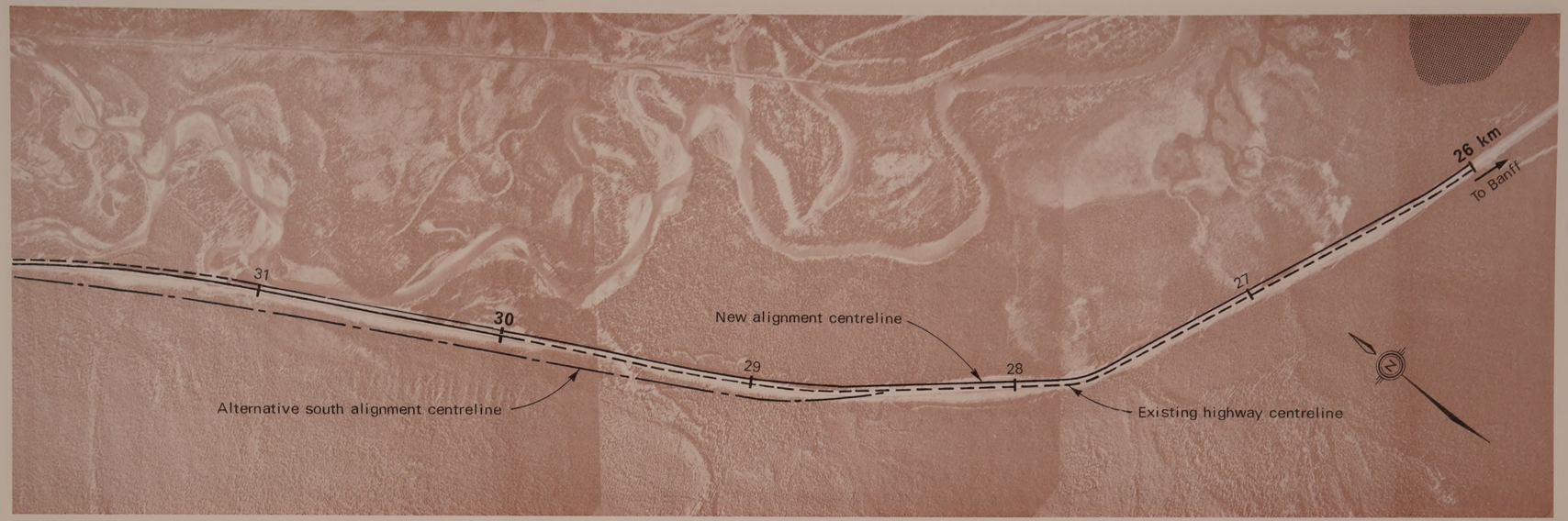
'C'
BARRIER SEPARATION
N.T.S.

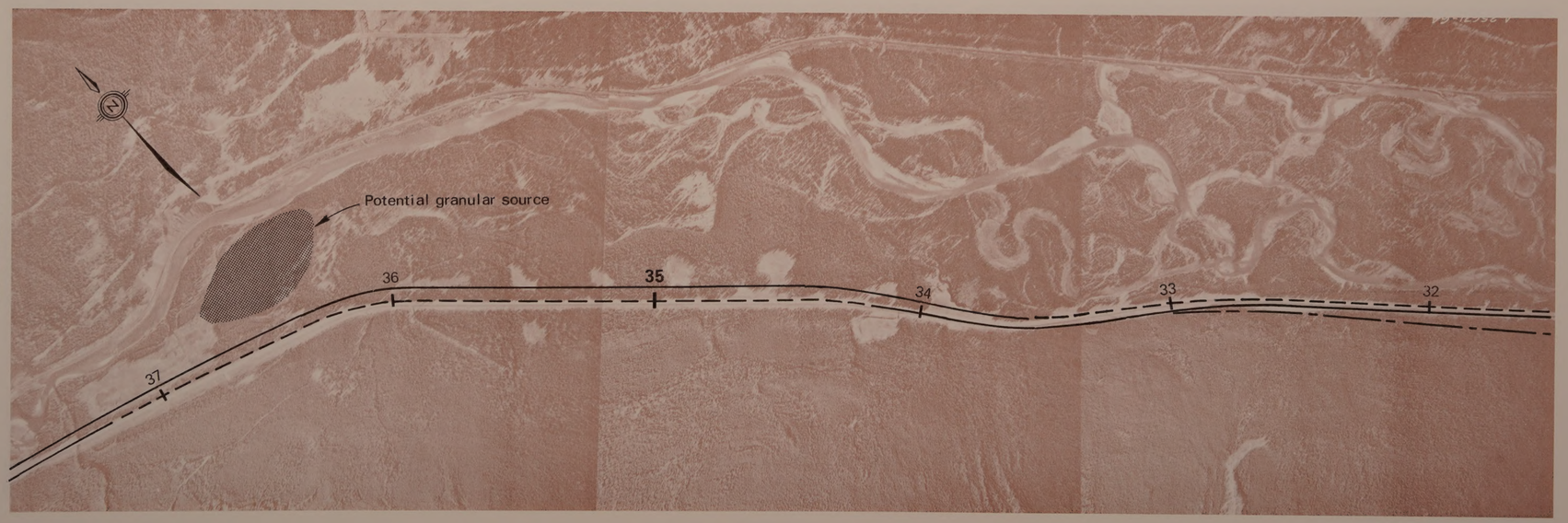


'D'
RAISED BARRIER SEPARATION
N.T.S.

PROPOSED IMPROVEMENTS
TYPICAL CROSS-SECTIONS

FIGURE 2.2-1





Refer to sheet 2

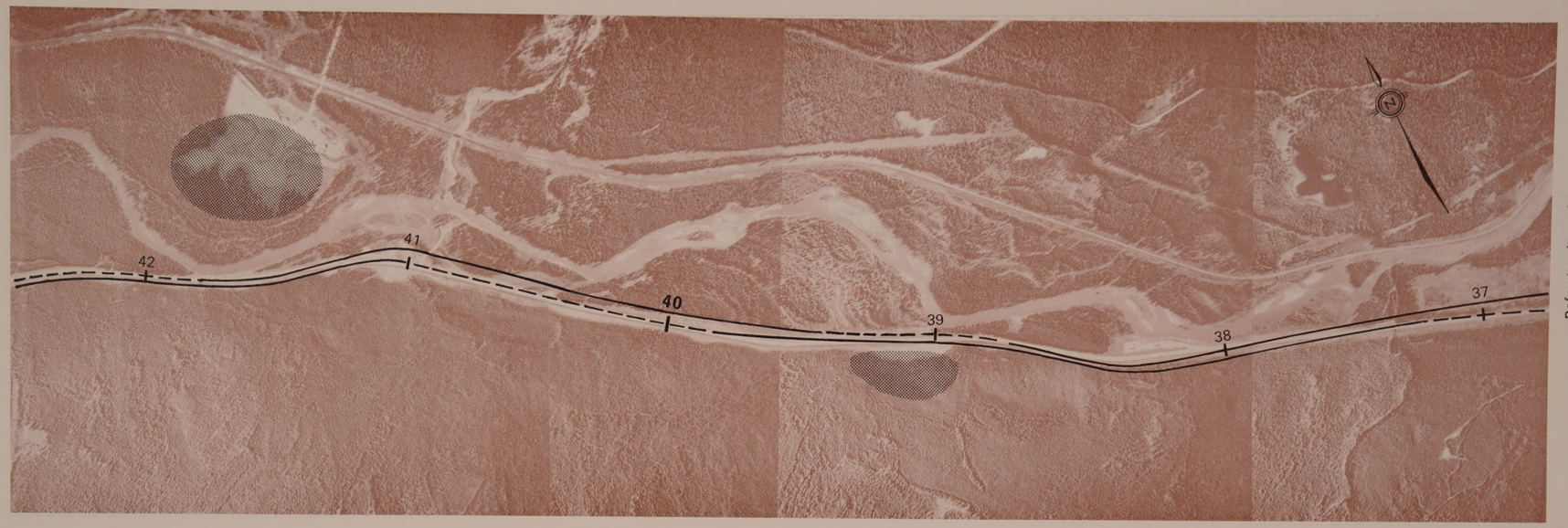
Scale 1: 20 000 (Approx.)

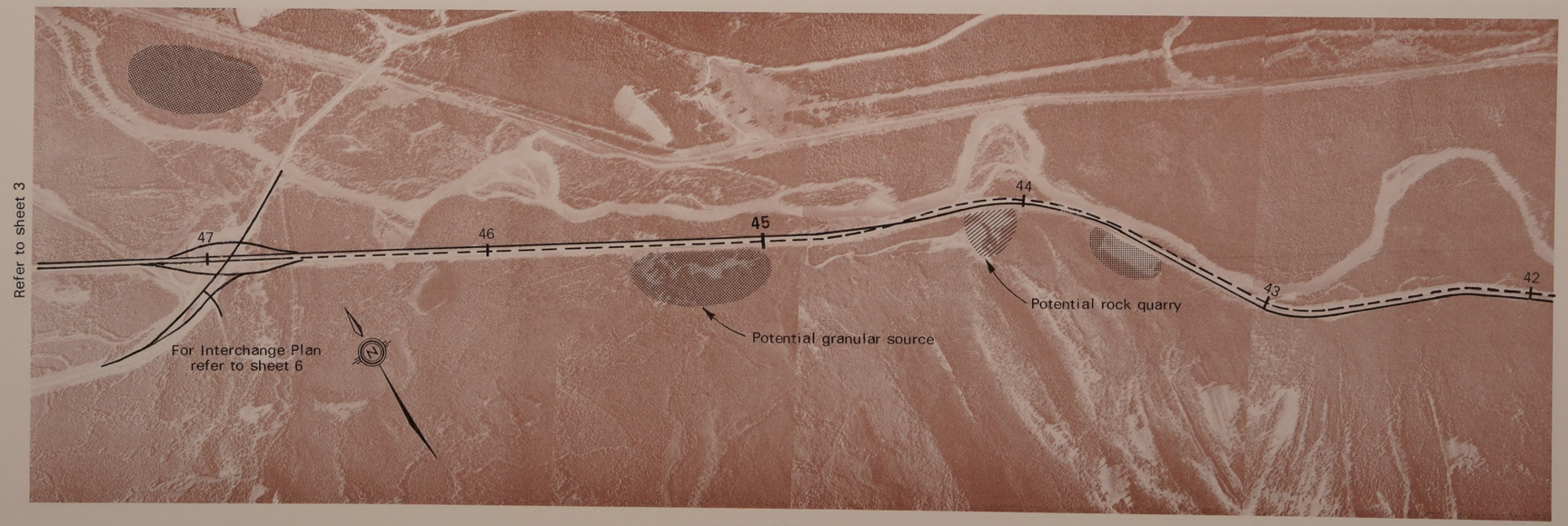
500 Metres 0 500

PROPOSED IMPROVEMENTS

Sheet 1

FIGURE 2.2-2





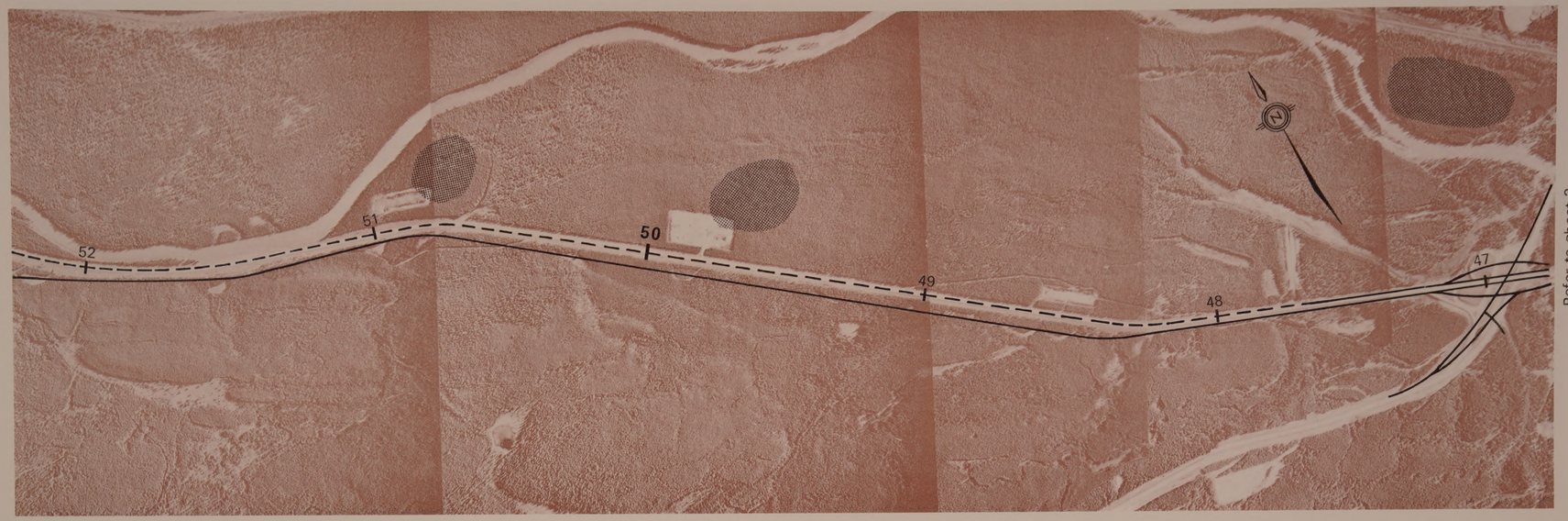
Scale 1:20 000 (Approx.)

500 Metres 0 500

PROPOSED IMPROVEMENTS

Sheet 2

FIGURE 2.2-2



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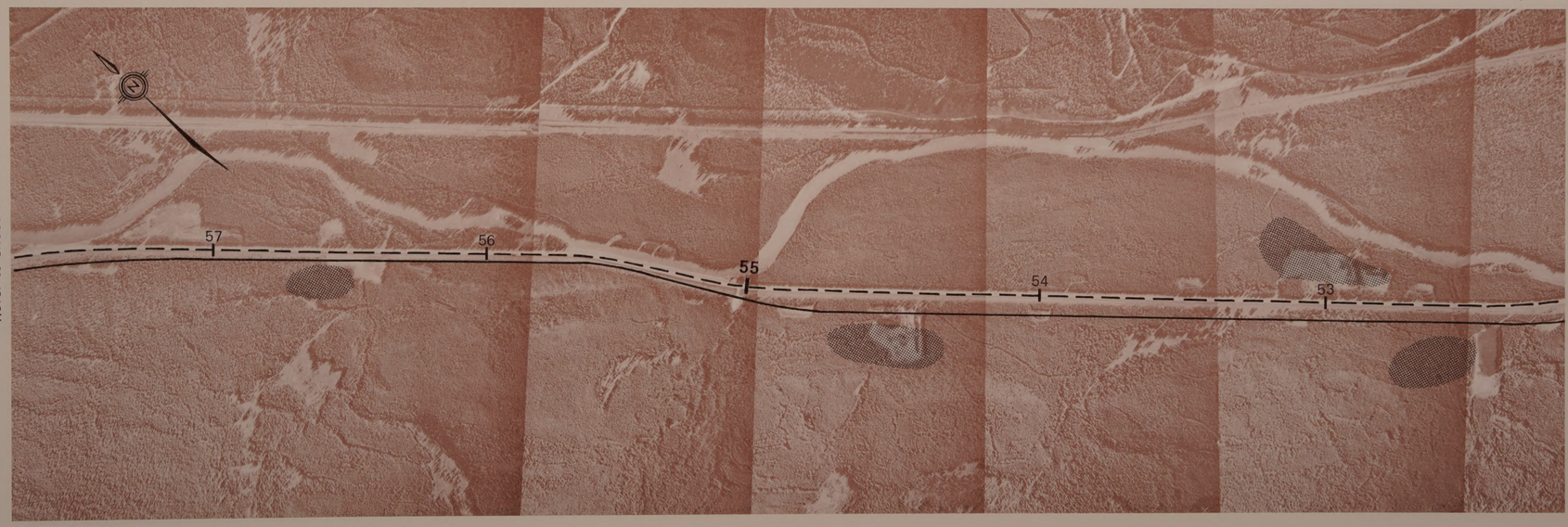

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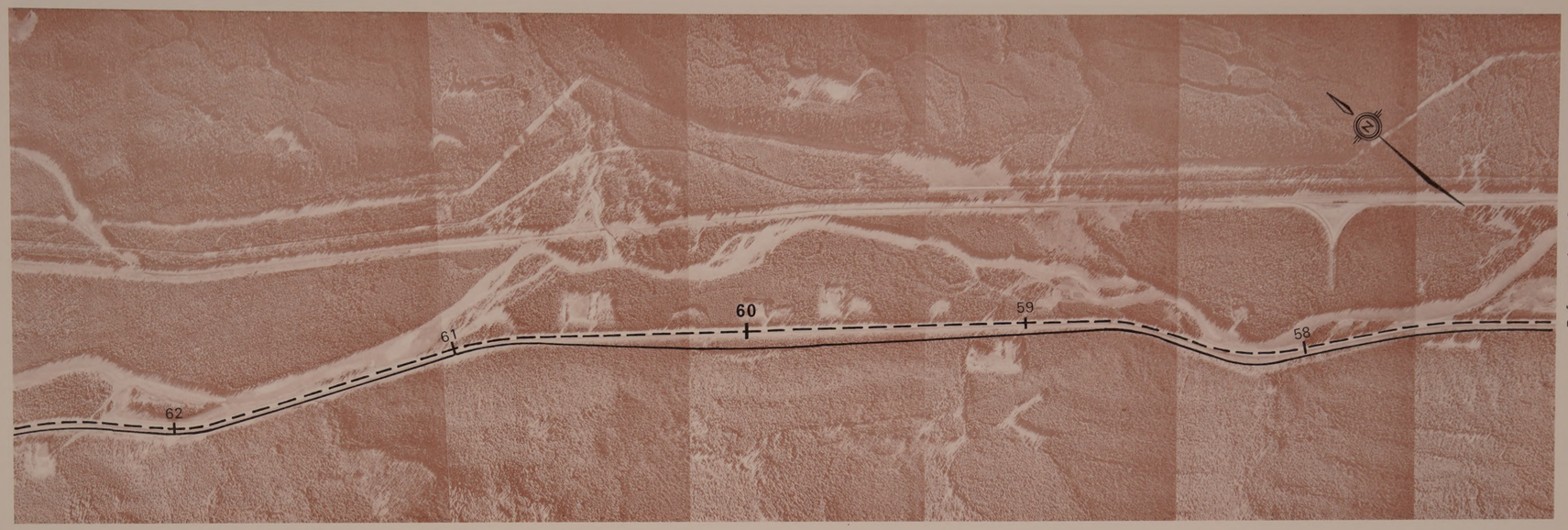
500 Metres 0 500

PROPOSED IMPROVEMENTS

Sheet 3

FIGURE 2.2-2



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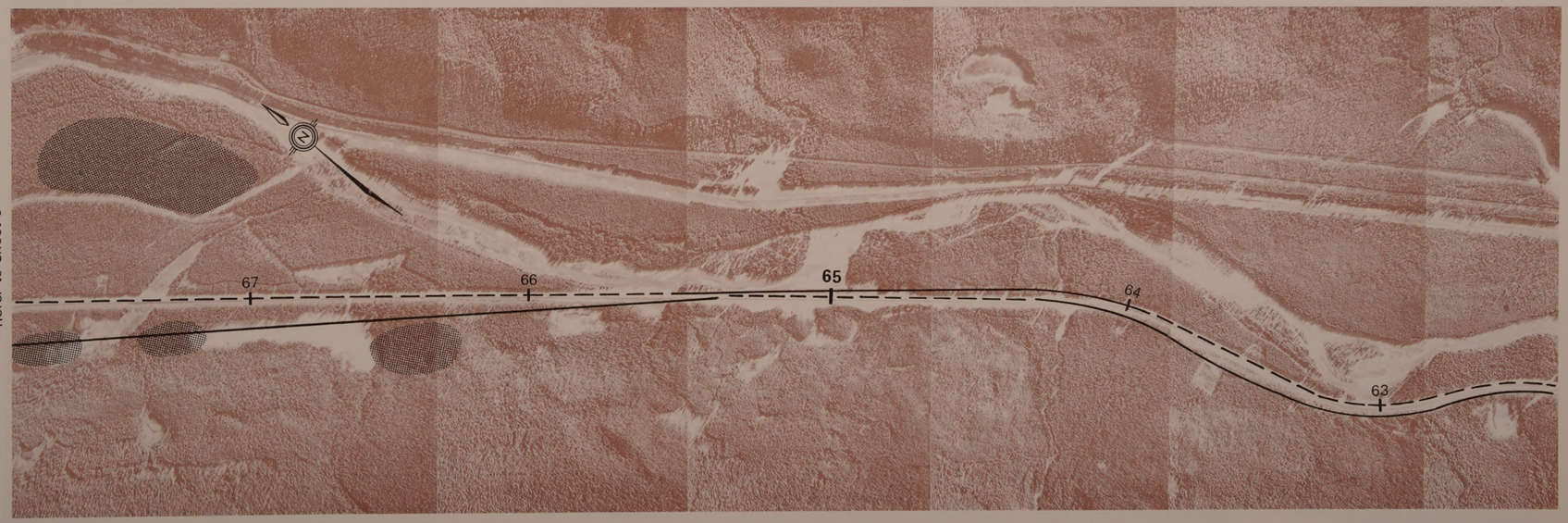


Refer to sheet 5

Scale 1: 20 000 (Approx.)

500 Metres 0 500

PROPOSED IMPROVEMENTS

Sheet 4

FIGURE 2.2-2

Scale 1: 20 000 (Approx.)

500. Metres 0 500

PROPOSED IMPROVEMENTS

Sheet 5

FIGURE 2.2-2

INTERCHANGE PLAN

Scale 1 : 7500

PROPOSED IMPROVEMENTS

Sheet 6

FIGURE 2.2-2

2.2.3 MATERIAL SOURCES

The proposed preliminary design utilizes excavated material from within the designed cut slopes for the major portion of the embankment material, resulting in a balance between cuts and fills from km 26.5 to km 69.0. Borrow would be required from km 69.0 to km 71.2. It is proposed that a portion of the additional borrow can be obtained from widening right-of-way cuts in the vicinity of km 67.6 to km 67.9 and further material could be obtained from the granular borrow pit currently being developed opposite km 68 for the Whitehorn Interchange. In addition, if the CPR subway is developed at Lake Louise approximately 35,000 cubic metres of material would be available.

Select granular material for base course and asphalt stabilized base would generally be obtained from areas outside the proposed right-of-way. Right-of-way cuts at km 39 and km 56.6 are potential sources of suitable granular material for base course.

Potential sources of granular material are shown on Figure 2.2-2. Areas indicated are granular sources except for km 44 which is a potential rock quarry. The specific site location can only be identified after final highway design details and soil subsurface investigations have been completed.

Prior to embarking on any drilling and testing, Public Works Canada would review the proposal with Parks Canada representatives in the field, to ensure minimum disturbance. Following the required subsurface exploration to prove the quality and quantity of materials available, Public Works Canada would produce for Parks Canada approval, detailed development and rehabilitation plans for the granular material sources.

The following estimated quantities of material are required for the proposed roadway improvements:

Base Course Class 2	190,000 cubic metres
Base Course Class 1	110,000 cubic metres
Cold Mix Aggregate	60,000 cubic metres
Hot Mix Aggregate for new pavement	70,000 cubic metres
Hot Mix Aggregate for pavement overlay	40,000 cubic metres

2.2.4 PRE-ENGINEERING SURVEYS

The preliminary design based on the ortho photo mosaics can be used as a basis for determining a feasible location for the new lanes. However, survey parties are required to stake the final centreline in the field for the purpose of obtaining accurate cross section topographic data, the location and extent of drainage sources, the extent of clearing limits, the location and extent of borrow sources and the location of turnouts to roadside services.

In areas where a Type A or Type B cross section is proposed, hand cutting of the proposed centreline would be required. In order to minimize the impact of cutting the survey centreline, the width would be restricted to a maximum 1.5 metres and clearing debris would be handled as approved by Parks Canada.

To minimize the adverse effects of ground surveys, air photo interpretation and mapping systems would be used extensively.

SECTION 2.3

CONSTRUCTION

2.3.1 PROJECT ADMINISTRATION

The Trans Canada Highway (TCH) Improvements will be carried out by Public Works Canada under the supervision of the Western Region Office. A project manager will be assigned responsibilities for the design and construction of the work.

The committee and subcommittee structure developed during Phase I and Phase II will be maintained as will the environmental coordinator position. This structure provides liaison between Public Works Canada and Environment Canada (including Parks Canada) during the design and construction stages.

Supervision of construction work will be the direct responsibility of Public Works Canada, the same agency that was responsible for the design and construction stages of the existing highway.

Monitoring of the environmental concerns and mitigating measures during construction will be carried out by Public Works Canada in collaboration with Parks Canada and the constituted committees. Expertise from the private sector, e.g. landscape architecture, wildlife, vegetation, aquatics and hydrology will be retained on an "as required" basis during design and construction.

2.3.2 CONSTRUCTION OPERATIONS AND SCHEDULING

General

Public Works Canada is conscious of the requirement to fully recognize the environmental, aesthetic and recreational sensitivities in the design and construction of the TCH Phase III improvements. Emphasis will be placed on minimizing adverse environmental impact and maximizing retention of aesthetic and recreational values.

Schedule

Construction of the improvements to the TCH is scheduled to take place over a period of seven years. The work is expected to progress as shown in Figure 2.3-1. This schedule is dependent upon the availability of funds.

The major portion of the work would be completed by the end of the fifth year followed by completion of the remaining paving in year six and completion of miscellaneous items in year seven.

Manpower and cash flow requirements are also summarized on Figure 2.3-1. The total estimated cost of construction is $74.5 million in 1985 dollars.

May, 1985

FISCAL YEAR

NO.	ACTIVITIES	1986/87 ONE	1987/88 TWO	1988/89 THREE	1989/90 FOUR	1990/91 FIVE	1991/92 SIX	1992/93 SEVEN	Est. Cost $ - millions
1.	Development of Castle Mountain Interchange Area at km 47. (Highway 93 Intersection to Radium Hot Springs, B.C.)								4.6
2.	Further Twinning in Lake Louise Area km 69-71 & km 73-75 (Note: Whitehorn Interchange already constructed as Parks Canada Project)								2.6
3.	Grading and Initial Paving, approx. 41 kms. (km 26-46 and km 48-69) - Including small structures.								44.0
4.	Final Paving (Including overlay of existing lanes.)								10.8
5.	C.P.R. Structure - km 70								2.5
6.	Bow River Structure - km 69								2.0
7.	Pre-Engineering & Design & Miscellaneous Items.								8.0

MANPOWER BREAKDOWN

	%	Person Years by Fiscal Year 1	2	3	4	5	6	7	total person years
Operators	44	10	68	95	98	90	27		388
Laborers	18	4	36	38	40	30	10		158
Supervisory	5	1	7	10	11	8	3		40
Misc. Trades	3	2	6	8	8	5			29
Engineering	30	18	48	62	67	45	15	10	265
	100	35	165	213	224	178	55	10	880

Manpower (person years) →	35	165	213	224	178	55	10	880	Total (person years)
Funds required ($ - Millions) →	3.2	14.8	16.5	18.5	15.0	4.5	2.0	74.5	Total ($ - Millions)

Cumulative cash flow required (capital works) $ - Millions

80
70
60
50
40
30
20
10
0

Gross wages and salaries for project labour forces :

	Person Years	Wages & Salaries $,000
Operators	388	10,780
Laborers	158	4,600
Supervisory	40	1,650
Misc. Trades	29	1,150
Engineering	265	9,385
	880	27,565

Note : Estimated costs in 1985 dollar.

CONSTRUCTION SCHEDULE,
MANPOWER COSTS

FIGURE 2.3-1

Clearing and Grubbing

The clearing and grubbing of the right-of-way will be carried out immediately prior to grading. Usable timber will be salvaged and all stumps and slash will be disposed by burying or burning. This work will form part of the grading contract.

If burning is necessary it will be subject to timing approval by Parks Canada.

Excavation, Grading and Borrowing

This work includes all embankment construction, borrow pit development, removal of unsuitable material, installation of culverts, slope stabilization, trimming, clean-up and rehabilitation of right-of-way. The work will take place over five consecutive construction seasons, from April to early November. Rock excavation may be carried out during the winter months. The final selection and treatment of gravel sources is contingent on the results of a materials investigation and acceptance and approval by Parks Canada of an extraction and rehabilitation plan.

The broad principles covering the development of borrow pits will be based on the implementation concept of Protection Planning. Protection Planning is defined as identifying project modifications to reduce, avoid or repair impacts. The following mitigative planning concepts will be considered:

- spatial containment; the restriction of environmental damage or change within the area required by a proposed development;
- sequential development refers to site development in a predetermined sequence that can reduce impact or facilitate reclamation. It can also refer to development of several pits in a particular sequence to meet impact mitigation and reclamation concerns;
- buffer zone; an area contiguous to a development site that remains in an undisturbed state. It serves to visually separate important resources from a development site and also provides a filter strip to reduce development impacts that cannot be contained;
- spatial modification; placement of development components to minimize impact and facilitate reclamation;
- spatial avoidance; development relocation to reduce or avoid impact;
- temporal avoidance; avoiding or reducing impact through appropriate timing of development activities;
- contrast reduction; reducing aesthetic impact by diminishing the visual contrast between developed area and surrounding landscape;
- ecological repair; the concept of reclamation to produce natural, self-supporting ecosystems on disturbed areas. This is in contrast to reclamation by growing "hay crops";
- habitat enhancement; ecological repair or selective manipulation to enhance habitat for specified wildlife use;
- contingency planning; environmental protection through advance preparation of plans and methods to stop or reduce impacts that cannot be predicted with certainty.

Reclamation planning (which is part of Protection Planning) further serves the purpose of reducing impact of development. Reclamation can be complex and visually considers several variables. Reclamation is optimized by considering wildlife concerns, the end use, ecological constraints (e.g. what plants will grow on the site), physical constraints (e.g. what are acceptable slopes for pit walls), and costs of such a program.

An overall and pit-specific reclamation plan will be developed prior to material extraction in collaboration with Parks Canada. This plan will be based on such information as: the time and sequence for reclamation, physical and biological methods to be used, and the final condition and subsequent use of the reclaimed pits.

Biological Surveillance will start as the site is developed. This is necessary to ensure that plans and specifications established for environmental protection are adhered to. The surveillance will also serve as a check on unexpected environmental problems that may lead to changes in the reclamation plan. Site reclamation will immediately follow development and in some cases will be concurrent with development.

Reclamation planning will also be developed and implemented for old borrow pits which are traversed by the new construction and which are visible from the existing highway and/or the new construction. Areas disturbed by previous highway construction which are not visible from the highway will be rehabilitated as is necessary to compensate for habitat lost through highway construction. These rehabilitation requirements will be defined by a program prepared by Parks Canada in collaboration with Public Works Canada.

Bridges, Interchanges and Other Drainage Structures

Construction of these structures will normally be scheduled between March and November. However, some foundation and substructure work could be carried out during the winter months. Scheduling will allow for mitigation of any identified impacts on fish resources.

A drainage system for the highway will be constructed to maintain as is practicable the existing drainage patterns (most of which have been modified by man) and thereby minimize environmental and structural damage.

The design of each crossing will carefully consider requirements for fish passage. The normal approach will be to design for a bridge crossing for streams which presently have a bridge. Where it is deemed necessary to accommodate fish passage, the selection, location and design of drainage structures will take into account the requirements outlined in Section 5.5 (Aquatics) of this document.

In general, small continuously or intermittently flowing streams will be handled by metal pipe culverts. Exceptions to the use of small pipe culverts on minor intermittent streams would be where steep gradients may produce heavy debris.

Paving

Paving work, being controlled by temperatures, must be scheduled between May and early October. The production of paving aggregate will be a separate contract or may be included in the paving contract. Production could be scheduled in colder months. The paving plant will be located in the selected gravel pit. The plant will be subject to the emission requirements of the "Alberta Clean Air Regulations" (Section 5.3).

Seeding and Landscaping

Topsoiling, seeding and landscaping may be included in the main grading contract or contracted separately.

2.3.3 MANPOWER AND HOUSING

Due to the distance of this project from developed areas of Canmore and Banff, the prime contractors may elect to use camps within the Park. Location of camps within the Park would be provided by the Proponent in collaboration with Parks Canada, and would be in the proximity of the project. All camps will be developed and managed by the proponent, using criteria developed by Parks Canada.

A wide variety of skilled personnel will be required by the contractors; these will include:

Superintendent	Cooks
Foreman	Bull Cooks
Mechanics	Flagman
Time Keepers	Scalers
Heavy Equipment Operators	Oilers
Drillers	Carpenters
Truck Drivers	Concrete Finishers
Labourers	Asphalt Plant Operators

Public Works resident engineering staff will be housed in Banff or Lake Louise. Local hired staff will use their own accommodation. The range of engineering personnel required for the project are listed below:

Design Engineers	Scalemen
Geotechnical Engineers	Checkers

Resident Engineers
Transitmen
Levelmen
Rodmen, Chainmen
Draftsmen

Time Keepers
Officemen
Soil Technicians
Inspectors
Asphalt
Technicians

2.3.4 TRAFFIC

During construction, highway travellers will be subject to traffic disruptions. Construction equipment will be working adjacent to the existing highway and reduced speed limits will be posted in these areas. Flagmen will be used at any locations of direct interference between construction equipment and highway traffic. Crossover points, where lanes switch across the existing highway, will be constructed late in the schedule and will have cold mix laid immediately after construction.

2.3.5 TREATMENT OF DISTURBED RIGHT-OF-WAY

The proposed improvements to the TCH do not involve abandonment of any sections of road other than short sections of existing pavement where crossovers occur. These areas are incorporated into the medians in all cases and therefore will interface with the median forms at both ends of the crossover points.

The rehabilitation and treatment of all areas disturbed by construction is described below.

Topsoil

An important component of the construction procedure will be stockpiling of organic topsoil from all excavated areas. This material will be re-spread over all areas disturbed by construction to facilitate revegetation/landscaping. Any surplus topsoil material will be used to rehabilitate former borrow pits which have a visual impact on the new or existing highway.

Construction Equipment

No unauthorized equipment operation will be allowed beyond the normal staked right-of-way. Specific suitable site locations within the right-of-way or in former borrow pits will be chosen for material storage, equipment, maintenance and fuel storage. The contractor's operation will be limited to these sites.

Right-of-Way

All areas (other than rock cuts) disturbed by construction will be shaped, topsoiled, seeded and fertilized. A landscape plan will be developed prior to construction showing proposed shaping, berm construction, and type and method of planting restorative vegetative cover.

SECTION 2.4

MAINTENANCE

Normal summer maintenance will consist mainly of mowing the grassed ditch sideslopes and median areas, and ensuring that culverts and other drainage structures are functioning. Pesticides and herbicides are not currently used, nor are they intended to be.

Normal winter maintenance would require the use of roll-over type snow ploughs so that snow could be ploughed to either side of the lanes. Deicing salt is currently used by maintenance crews. For the existing 2-lane highway, an average of 45 tonnes/km per annum of sodium chloride is applied between the Sunshine Turnoff and the Icefields Parkway Junction. Approximately twice this quantity would be utilized on the improved highway.

Minimizing the use of Type C and D concrete barriers reduces both summer and winter maintenance.

Periodic maintenance will be required to scale rock cuts, to repair any serious erosion of earth cutslopes, and to clean out adjacent ditches. This work would normally be done after the spring runoff season.

Preventive maintenance of the pavement and shoulders will be done as required and would comprise such operations as crack filling, patching, spot sealing, etc. Pavement markings will be renewed annually or more frequently as needed. Road signs will be replaced when required.

It is estimated that the annual cost of maintenance will be $265,000. This will require 4.6 additional person-years.

3

Existing Environment and Resource Use

SECTION 3.1

TERRAIN

3.1.1 SURFICIAL GEOLOGY

The distribution of surficial deposits in the vicinity of the TCH between the Sunshine and Jasper turnoffs, is shown on Figure 3.1-1. As described below, these deposits are of both glacial and postglacial origin.

Glacial Deposits

Ground moraine, consisting of clayey to gravelly till is the dominant glacial deposit within the study area. It occurs in the valley bottom and underlies the lower valley slopes throughout the project area. Ground moraine characteristically gives rise to undulating to rolling terrain. Surface drainage (except in depressions, where poorly-drained organics frequently exist) is fairly good. The till occurs both as a relatively thick deposit or as a shallow veneer over bedrock (Map Units 6a and 6b respectively on Figure 3.1-1).

Sands and gravels of glaciofluvial origin occur south and west of the Castle Mountain Interchange. These deposits were laid down by glacial meltwater, as glaciers retreated up the Bow River valley and towards the Continental Divide. They range from clean gravels (e.g. in the gravel pit west of the Interchange) to glacial till-like material. Surface drainage is usually quite good. However, perched groundwater tables occur locally as for example along Highway 93 west of Castle Mountain Interchange where unstable sidehill cuts are extensively developed.

Colluvium

Colluvium, formed by slopewash and insitu weathering, occurs throughout the study area. It is most noticeable in steeper, bedrock-controlled areas where it forms a veneer over the bedrock. An example is the bedrock ridge, veneered by shallow colluvium, that descends to the north from Copper Mountain about 2 km southeast of Castle Mountain Interchange. Colluvium typically has a very variable composition, ranging from clay to gravel, often with inclusions of till and bedrock fragments. Generally, the relief is a reflection of the underlying bedrock (or surficial deposits). Drainage is usually good. Mass wasting processes, such as landslides, also give rise to deposits (slide debris) that are considered to be colluvial in origin. The debris from a large rock slide in the Johnston Canyon area, occupying the valley floor northeast of the Redearth Creek - Bow River confluence, is a good example.

Lacustrine Deposits

These materials, primarily organic-rich silts and clays, are restricted to recent lake basins and have a limited distribution within the study area. Mud, Island and Copper Lakes are examples.

Alluvial Deposits

Granular materials, laid down by recent and on-going fluvial processes, are by far the most abundant postglacial deposits. Floodplains, terraces and fans are distributed throughout the valley bottom and lower slopes. The deposits, notably those contained within the fans, are very variable but generally comprise silty sand to gravel and cobble size material. The alluvial fans also sometimes include massive bedrock fragments. Surface drainage of the alluvial deposits is usually good; high groundwater tables exist in the floodplain and fan areas.

Organic Materials

Terrain depressions throughout the study area are infilled with poorly-drained organic bog and fen deposits that have accumulated since deglaciation. Only the more extensive of these deposits are mapped on Figure 3.1-1.

3.1.2 BEDROCK

The project area is located within two major subdivisions of the Western Cordillera: the Front Ranges and the Main Ranges. Each comprises bedrock formations that are quite different in age and have characteristic lithologies and structure. The boundary between the Front and Main Ranges occurs just south of Castle Interchange, crossing the TCH between km 45 and 46.

Front Ranges

The Front Ranges consist predominantly of Palaeozoic carbonate rocks; dolomites and limestones of Devonian to Mississippian Age. As a result of thrust-faulting from the southwest, these strata are frequently steeply inclined. The Sawback Range to the east of the project in the Sunshine Turnoff area is a good example. Topographically low areas, between the steeply-dipping carbonate ridges, are underlain by the Mesozoic siltstones, sandstones and shales over which the Palaeozoics were thrust. Bedrock exposures in existing sidehill cuts consist mainly of the Palaeozoic strata (thin bedded to massive limestones).

Main Ranges

The dominant lithologic types within the Main Ranges are carbonates and quartzites of Cambrian age and Precambrian slates. These formations are relatively undeformed and generally flat-lying. The Cambrian formations occur within two broad synclines, that parallel the Bow River Valley to the northeast and southwest, and outcrop high on Castle Mountain, Mount Temple, and the other major peaks. The Precambrian strata, on the other hand, are distributed in the valley bottom, where they occur in the eroded core of a major anticline (situated between the two synclines). These slates, generally thin to medium bedded and fissile, are exposed in the majority of existing sidehill cuts between the Castle Mountain Interchange and the Icefields Parkway Interchange.

3.1.3 TERRAIN-RELATED PROCESSES

A number of active geomorphic processes could potentially impact the proposed project. The characteristics and distribution of the most significant of these are briefly summarized below.

Snow Avalanches

Two areas of snow avalanche activity have been identified. The first of these is on the northeast face of Massive Mountain, in the vicinity of km 33 to 35, where several active avalanche chutes are visible. Similar conditions exist on the northeast face of Copper Mountain, in the vicinity of km 42 to 44, where there are approximately ten active avalanche chutes. None of these avalanches reach or threaten the highway.

Rockfalls and Rockslides

Minor rockfalls and ravelling commonly occur in those sidehill cuts where bedding and jointing are particularly unfavourable (e.g. in the vicinity of the Icefields Parkway Interchange). In addition, a large inactive rockslide is located on the north side of the Bow River, close to Johnston Canyon. Slide debris extends down to the river (Figure 3.1-1). Airphoto interpretation and field observations did not identify any large slide areas elsewhere in the project area.

Erosion

The existing highway is suitably protected against the continuing process of erosion by the Bow River and its tributaries. In addition, shallow gully erosion occurs on a number of steep glacial till slopes, especially where seepage zones are present. However, this process is likely of relatively minor significance.

Cut Slope Stability

Most existing sidehill cut slopes along the TCH are performing satisfactorily, and exhibit little evidence of instability (see Section 5.1 for details). However, a few cuts are affected by minor surface sloughing, and two cuts (out of a total of 38 that were examined) exhibit rotational sliding and flow slide development. The distress apparent at these latter locations is related to unfavourable perched groundwater conditions and/or overly steep cut slopes.

3.1.4 UNIQUE GEOLOGICAL FEATURES

No geological or terrain features that might be considered rare or unusual in the context of the Park were observed in the vicinity of the proposed project.

GEOLOGY AND TERRAIN

Sheet 1

FIGURE 3.1-1

GEOLOGY AND TERRAIN

Sheet 2

FIGURE 3.1-1

GEOLOGY AND TERRAIN

Sheet 3

FIGURE 3.1-1

SECTION 3.2

HYDROLOGY AND STREAM REGIMES

The principal hydrologic features along the TCH between the Sunshine Road west of Banff and the Icefields Parkway at Lake Louise are:

(i) numerous points of contact between the existing highway and the Bow River,

(ii) crossing of a number of streams draining north-facing slopes, and

(iii) some contact with valley wetlands.

The highway is located to the south of the Bow River (except over the last 5 km near Lake Louise) and entirely along the valley bottom or its edge. The locations of hydrologic features are shown in Figure 3.2-1.

Between Sunshine Road and Castle Mountain Junction, the Bow River follows a series of irregular meander bends in a valley bottom approximately 1 km wide. West of Castle Mountain Junction, the channel pattern is better described as sinuous and irregular, and the valley bottom is mostly about 0.5 km wide. The construction of the existing highway during the 1960s involved a number of contacts with and encroachments on the channel of the Bow River. At most of these locations the encroachment appears to have been minor, and has been protected locally with rock riprap on the embankment. At one or two locations, however, the straight cut appearance of the present north bank of the river indicates that some excavation and re-channelization was done to shift the river to the north.

3.2.1 GENERAL CLIMATIC CONDITIONS

Banff and adjacent mountain parks have an essentially temperate continental climate. The sector of highway between the Sunshine Road and Lake Louise lies in a relatively dry portion of the Park where there is a high range between winter and summer average temperatures. Between the Sunshine Road (km 28) and Castle Mountain Junction (km 47) the precipitation regime is essentially similar to that at Banff. Between Castle Mountain Junction and the Icefields Parkway (km 75) winter snowfall and annual precipitation increase notably.

The climate along the route can be evaluated from data for the stations at Banff and Lake Louise, shown in Figure 3.2-2. The station at Banff was established in 1887, and hourly observations of temperature, precipitation, and wind have been recorded since 1894. The station at Lake Louise was established in 1915 and has continuous temperature and precipitation data since 1918. A summary of climatic data for the two stations is shown in Table 3.2-1. A detailed discussion of several climatic factors can be found in the Phase II EIS (Public Works Canada, 1981).

3.2.2 PRECIPITATION

Annual precipitation at Lake Louise is approximately 60% greater than at Banff. It is likely that most of the increase occurs between Castle Mountain Junction and Lake Louise. As shown by Tables 3.2-1 and 3.2-2, nearly all of the difference is due to much greater snowfalls at Lake Louise in the months of November through April. The annual snowfall at Lake Louise is 120% greater than at Banff.

Twenty-four hour rainfall frequency curves for the general area including Lake Louise, and 1-hour to 24-hour intensity-duration frequency curves, are given in the Phase II EIS (Public Works of Canada, 1981). Selected figures for short-duration rainfall are given in Table 3.2-1.

Extreme flood flows in streams are, in general, caused by rain-on-snow events at higher elevations. Because the rainfall tends to coincide with high snowmelt rates and because of the uncertain position of the freezing level in these storms, it is impossible to analyse such events using rainfall data. Extreme discharges are generally due to high soil moisture levels during snowmelt, rather than high snowmelt rates associated with the rainstorm. Rainstorms of similar intensity in late summer do not result in comparable peak discharges because soil moisture levels are usually low.

3.2.3 STREAM FLOW

Within the study area, published stream flow data are available for the Bow River at Lake Louise (km 72.5), for Redearth Creek at the existing highway (km 37.3), and for the Pipestone River at Lake Louise (km 72.8). The Pipestone River crossing is not within the scope of the present study, having already been constructed under the Lake Louise area improvements. No other streams intersected by the highway between the Sunshine Road and the Icefields Parkway are gauged. There are, however, records for a number of streams on the north side of the valley and east of the Sunshine Road, including Johnston Creek (opposite Redearth Creek), Brewster Creek (just east of the Sunshine Road), Forty Mile Creek at Banff, and Bow River at Banff. These gauges together with precipitation stations are shown in Figure 3.2-2. Monthly flow distributions are also shown for the Bow River at Lake Louise and for Redearth Creek. Similar plots for Brewster Creek, Bow River at Banff, and Forty Mile Creek are provided in the EIS for Phase II (Public Works Canada, 1981). The regimes of streams like Redearth Creek, whose basins extend to the high mountain elevations, are dominated by upper level snowmelt, usually in June and July but sometimes in May.

Winter flows in the Bow River at Lake Louise are roughly 20% of those at Banff, which corresponds closely to the ratio of drainage areas. In the summer months, flows at Lake Louise are up to 35% or so of those at Banff, due to the higher proportion of icefields and high elevations above Lake Louise. A similar relationship prevails with flood flows: the record flood discharge at Lake Louise is 123 m^3/s (in 1918) as against 377 at Banff (in 1923). The highest flow at Banff in recent years was 320 m^3/s in 1972. Minimum flows at Lake Louise are less than 1 m^3/s as against about 5 at Banff.

TABLE 3.2-1: SUMMARY OF CLIMATIC DATA FOR BANFF LAKE LOUISE

PARAMETER	BANFF	LAKE LOUISE
Elevation, m	1400	1530
Mean annual precipitation, mm	477	768
Mean annual rainfall, mm	274	285
Mean annual snowfall, mm	2190	4820
Snow water equiv. April 1, mm (mean annual)	147 (Castle Junction)	213
Mean Jan. temperature, °C	-11.2	-14.7
Mean July temperature, °C	14.5	12.3
No. of days with frost, annual	221	271
No. of days with frost, 1 June - 30 September	15	41
24-hour max. rainfall, 25-year return period, mm	50	40
1-hour max. rainfall, 10-year return period, mm	8	8

Sources:

- Public Works Canada, 1981.
- Janz, B. and D. Storr, 1977.

TABLE 3.2-2: MONTHLY PRECIPITATION AND SNOWFALL FOR BANFF AND LAKE LOUISE

LOCATION	MONTHLY PRECIPITATION (Jan. - Dec.)												TOTAL (Annual)
Banff													
Total precipitation, mm	33	29	23	36	51	65	48	48	38	36	35	34	477
Snowfall, cm	36	30	23	30	9	1	--	--	6	18	32	34	219
Lake Louise													
Total precipitation, mm	83	63	45	53	51	62	59	59	50	60	85	98	768
Snowfall, cm	83	62	45	46	18	1	--	--	4	41	84	98	482

Refer to sheet 2

HYDROLOGIC FEATURES

Sheet 1

FIGURE 3.2-1

HYDROLOGIC FEATURES

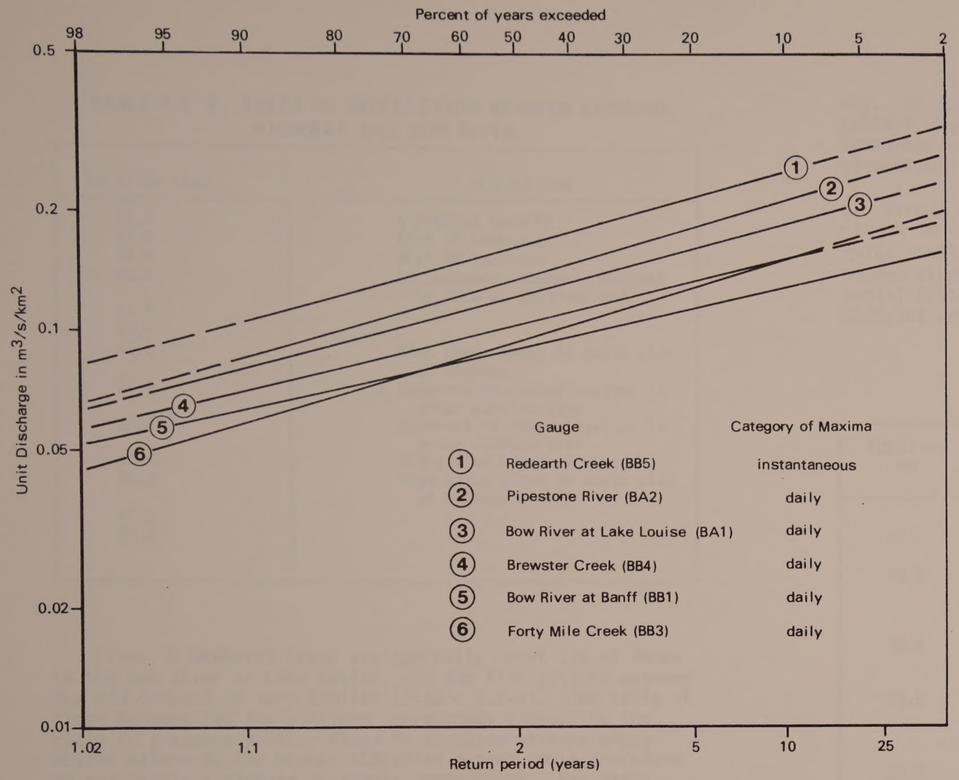
Sheet 2

FIGURE 3.2-1

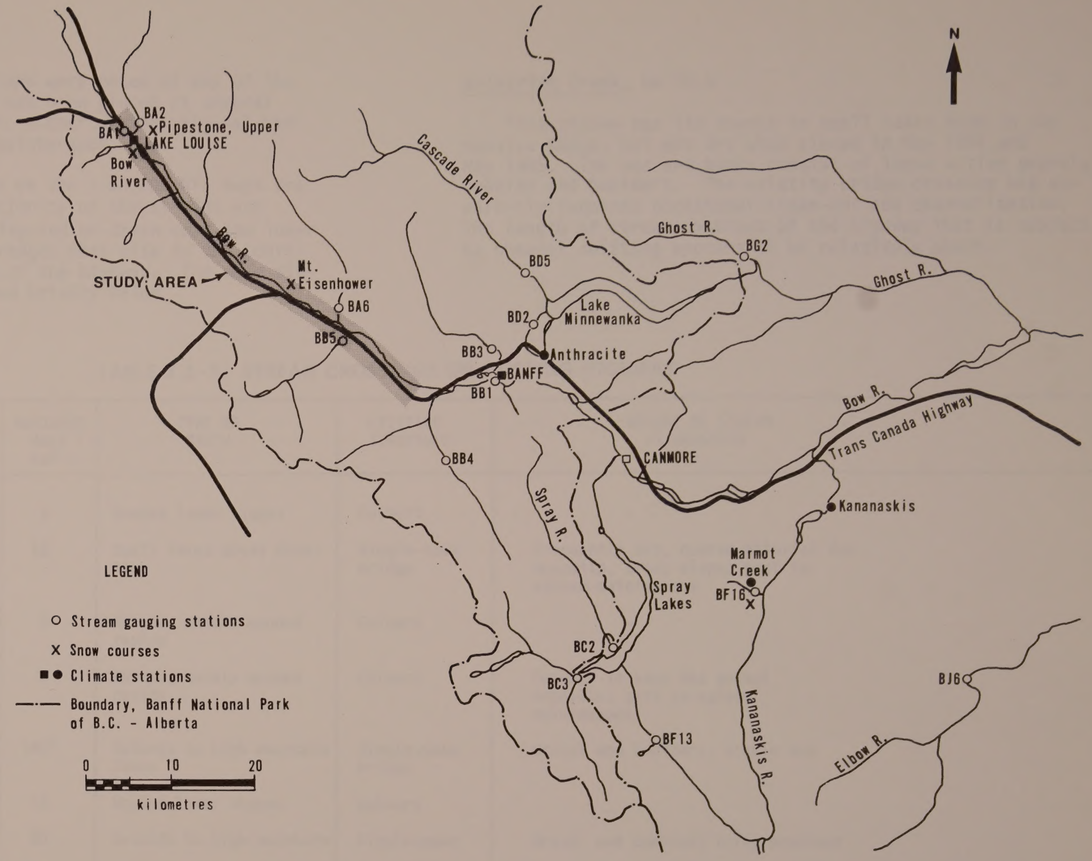
HYDROLOGIC FEATURES

Sheet 3

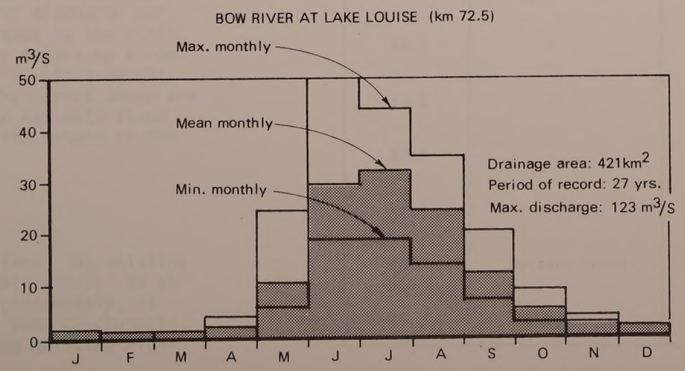
FIGURE 3.2-1

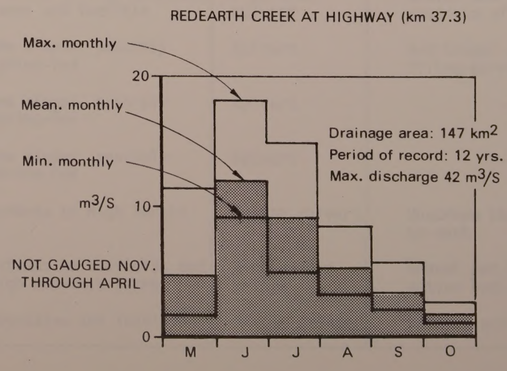


FLOOD FREQUENCY CURVES



PRECIPITATION AND STREAM FLOW DATA LOCATIONS





MONTHLY FLOW DISTRIBUTIONS

FIGURE 3.2-2

TABLE 3.2-3: AREAS OF INTERACTION BETWEEN EXISTING HIGHWAY AND BOW RIVER

LOCATION (km)	DESCRIPTION
30.5	Riprapped locally
37.8	East of look-out
39.0	West of look-out
40.6	On secondary channel, blocked by dike at upstream end
41.7	-
43.7	-
44.5	High steep slope on south side of highway
51.5	Apparent re-channelization in prior construction
55.5	Apparent re-channelization in prior construction
57.5	Attractive reach of river
58.3	High steep slope on south side of highway
61.5	-
65.2	-

Flows in Redearth Creek are generally about 33% of those in the Bow River at Lake Louise, and the flow pattern between May and October is very similar (Figure 3.2-2). The ratio of flows between the two stations corresponds closely to the ratio in drainage areas. Flows in unguaged streams whose basins extend to the higher elevation ranges could therefore be reasonably estimated by simple proportions. For those streams draining lower slopes only, flows per unit of basin area are probably considerably less, and the streams are likely to flow significantly only during snowmelt and wet periods. A listing of streams crossing the highway, with their basin and channel characteristics, is given in Table 3.2-4. The only streams likely to be of value for fish are those fed by lakes, icefields or springs.

Figure 3.2-2 shows flood frequency curves for a number of streams in the area, based in part on a diagram in the Phase II EIS (Public Works Canada, 1981). The curves have been consolidated by expressing flows in terms of discharge per unit of basin area. As in the case of streams in the vicinity of Banff, extreme floods are generally caused by a combination of basin-wide rainfall with upper levels snowmelt, under conditions of high soil moisture. The curves shown are very similar in nature and could be used to estimate flood flows for those ungauged streams whose basins extend to the higher levels.

3.2.4 RIVER AND STREAM CONDITIONS

The most important areas of contact between the existing highway and the Bow River are listed in Table 3.2-3. In at least two cases, at km 51.5 and km 55.5 approximately, it appears that substantial encroachments and some re-channelization were done during construction of the existing highway. No active erosional problems were noted at any of the contact areas, but rock riprap has been placed at several locations as erosion protection, either during original construction or in the course of maintenance.

Stream crossings detectable on the 1:50,000 NTS maps are listed in Table 3.2-4. The majority of the streams are quite small and are either spring-fed or drain only the lower wooded slopes of the mountain ranges that rise to the Continental Divide to the southwest of the highway. The more significant crossings are discussed briefly below.

TABLE 3.2-4: STREAM CROSSINGS ON EXISTING HIGHWAY

LOCATION km	NAME	DRAINAGE AREA km^2	TYPE OF BASIN	EXISTING STRUCTURE	NATURE OF STREAM AT CROSSING
27.5	-	5	Wooded lower slopes	Culvert	-
29.6	Wolverine Creek	18	Small lakes above tree-line	Single-span bridge	Frequently dry, coarse alluvial fan deposits, steep slope; past in-stream maintenance
32.4	-	5	Narrow, mainly wooded ravine	Culvert	-
35.5	-	7	Narrow, mainly wooded ravine	Culvert	Channel in sand and gravel deposits; past in-stream maintenance
37.3	Redearth Creek	147[1]	Extends to high mountain lakes	Single-span bridge	Gravel and boulders; stable bed
44.8	-	14	Wooded lower slopes	Culvert	-
46.8	Altrude Creek	80	Extends to high mountain	Single-span	Gravel and cobbles; icing problems
51.0	-	2	Low slopes, probably spring-fed	Culvert	-
52.6	-	8	Wooded gully on lower slopes	Culvert	-
55.2	Taylor Creek	15	Extends to high mountain lakes and icefield	Pipe-arch culvert	Gravel and boulders; channelized upstream of highway
56.1	-	2	Low slopes, possibly spring-fed	Culvert	Additional drop culvert through re-filled borrow pit upstream
58.0	-	2	Low slopes, possibly spring-fed	Culvert	-
59.1	-	2	Low slopes, possibly spring-fed	Culvert	-
62.9	-	7	Extends to high levels	Triple culvert	Upstream channel parallels highway to east
64.2	Moraine Creek	60	Extends to icefields and high mountain lakes	Single-span bridge	Gravel and boulders, steep slope, active bedload transport
69.3	Bow River	421[1]	Mountains and icefields	3-span bridge	Cobbles and boulders, stable bed

[1] Drainage areas as reported by Water Survey of Canada.

Wolverine Creek, km 29.6

This stream has its source in small lakes high in the Massive Range, but was dry when viewed in May 1984 and May 1985. The bed and banks consist of loose active gravel, cobbles and boulders. The existing bridge crossing has apparently required occasional clean-out and channelization. The length of stream upstream of the highway that is subject to channel shifting appears to be relatively short.

Un-named Creek, km 35.5

This small stream draining a ravine on the north slopes of Massive and Pilot Mountains has also required channelization and clean-out upstream of the culvert crossing. The channel upstream of the highway has been straightened over a length of several hundred metres.

Redearth Creek, km 37.3

With the exception of the Bow River, this is the largest stream in the study area. The channel is boulder-paved and stable and there is no indication of problems with the existing bridge crossing. A Water Survey of Canada stream gauge, operated from 1 May to 31 October since 1973, is located on the northeast wingwall of the bridge.

Altrude Creek, km 46.8

Altrude Creek and its tributaries originate from a number of high-elevation lakes near the Continental Divide. The creek is presently crossed by a single-span bridge on the highway just east of the Castle Mountain Interchange. The channel is stable, with a gravel and cobble bottom. When viewed on May 1, 1985 the bridge waterway was partly occupied by consolidated snow and ice, but the stream was flowing freely. Approximately 350 m upstream, the stream is carried through a gravel access road to a work camp by a culvert, but the capacity is obviously insufficient for flood flows which consequently overtop the road.

Taylor Creek, km 55.2

This stream originates from Taylor Lake, fed by a small icefield on Panorama Ridge. It crosses the existing highway in a metal pipe-arch culvert with a small drop at the outlet.

Un-named Creek, km 56.4

This quite small stream passes through an old borrow area upstream of the highway. Part of this area was re-filled and a steep drop culvert installed after original highway construction, probably to avoid erosional problems in the re-filled ground.

Un-named Creek, km 62.9

This small stream originates from the northwest end of Panorama Ridge. It runs 80 m south of the existing highway and more or less parallel to it over a distance of about 200 m before passing through a triple pipe culvert.

Moraine Creek, km 64.2

Moraine Creek drains the Valley of the Ten Peaks, Moraine Lake and other lakes, icefields and glaciers near the Continental Divide. At the highway it has a steep slope, a moderately unstable channel, and an active bed of coarse gravel and boulders. The existing highway crosses on a single-span bridge.

Bow River, km 69.3

At this location, the river has a stable channel with boulder-paved bed and banks.

3.2.5 WATER TEMPERATURES AND ICE CONDITIONS

Water temperature data for the Bow River at Banff and at Lake Louise are summarized in Table 3.2-5. Dates of freeze-up and break-up are summarized in Table 3.2-6.

3.2.6 WETLANDS

Small areas of wetlands are located to the north side of the highway at km 27 to 28, (just west of the Sunshine Road) and at km 47 to 48 (just west of the Castle Mountain Interchange). There are no large areas comparable with the Vermilion Lakes near Banff.

TABLE 3.2-5: WATER TEMPERATURES FOR THE BOW RIVER

MONTH	BANFF °C	LAKE LOUISE °C
March	1.0	0.5
April	2.1	2.8
May	4.2	4.4
June	7.8	7.8
July	10.8	10.8
August	10.6	10.0
September	7.3	7.8
October	3.8	3.9
November	1.3	0.6

Source:

- Water Survey of Canada, 1976.

TABLE 3.2-6: ICE CONDITIONS

	FREEZE-UP				BREAK-UP			
	mean	earliest	latest	Years Record	mean	earliest	latest	Years Record
Banff	Nov. 21	Oct. 24	Jan. 13	52	April 4	Jan. 27	May 6	54
Lake Louise	Nov. 10	Oct. 26	Nov. 22	9	April 16	Mar. 22	May 11	8

Source:

- R. Kellerhals, C.R. Neill and D.I. Bray, 1972.

SECTION 3.3

AIR QUALITY

3.3.1 PERTINENT NATURAL ASPECTS

The frequency of fog and low cloud at the Banff station is low. Fog may persist in the Vermilion Lakes area during temperature inversions but fog frequency data are not available. Air quality and local visibility may also be affected by smoke and haze during periods of temperature inversions.

3.3.2 MAN-MADE EFFECTS ON AIR QUALITY

Although the air quality in the area has not been monitored, pollution in general does not appear to be a problem. The corridor is well ventilated and there is a lack of industry and major point sources of pollution.

An exception to the above condition develops during periods of congestion on the highway. For a given volume of traffic, air pollutant concentrations from trucks and automobiles increase with slower speeds. When traffic flow breaks down to "stop and go", air pollutant concentrations can increase markedly to unacceptable levels (i.e. above 40 mg/m^3)*.

*The United States Environmental Protection Agency (U.S. EPA) has established National Ambient Air Quality standards (NAAQs) for major air pollutants, including carbon monoxide (CO) which is the most common pollutant emitted by automobiles. The maximum allowable one-hour concentration of CO is 40mg/m^3. The Canadian Clean Air Act - Regulations and Guidelines, define a desirable one-hour concentration of carbon monoxide as 0-15mg/m^3.

SECTION 3.4

VEGETATION

The Montane and Lower Subalpine Ecoregions of the study area have been investigated by Holland & Coen (1982) as part of the biophysical land classification study of Banff and Jasper National Parks. Each region has been divided into ecosections which differ in genetic materials and drainage classes as reflected by landform features. In the Lower Subalpine Ecoregion, a primary subdivision is made between calcareous and non-calcareous environments.

The ecosections are further sub-divided into ecosites, on the basis of soil characteristics, vegetation physiognomy, and to a lesser extent vegetation composition (Walker et al 1982a). The ecosite descriptions (Walker et al 1982b) provide information on landforms, soils and vegetation types, the last of which are described in more detail by Corns & Achuff (1982). This Initial Assessment has drawn substantially on these sources.

3.4.1 BIOPHYSICAL LAND CLASSIFICATION

Table 3.4-1 summarizes the locations of ecosites within the study area. These locations are shown on Figure 3.4-1.

Details of vegetation types, rare species potential, and ecosite descriptions are provided below. A detailed breakdown of the vegetation types is provided in Table 3.4-2. There are 13 closed forest types - C3, C4, C5, C6, C9, C13, C14, C18, C19, C20, C29, C30, and C32; four open forest types - O3, O6, O11, O17; three shrub types - S1, S3, and S7; and three herb types - H3, H8, and H11.

The predominant vegetation along the benchlands above the Bow River is a dry to mesic lodgepole pine woodland. On north-facing slopes, forests of spruce and fir become more common and there are scattered shrub fens. Along the floodplain of the Bow River are spruce forests and extensive shrub fens and sedge wetlands.

The most widespread vegetation types in the study area are the closed forests of pine and spruce. The drier pine woodlands have a very low potential for rare species while the moister spruce woods have a low potential. Because of their visual attractiveness and the presence of uncommon or rare species, the wetland shrub and herb vegetation are considered to be the most significant vegetation types.

A field reconnaissance was undertaken to assess the accuracy of the biophysical land classification and to investigate anomalous sites. The results verify that the biophysical land classification is a good guide for the general vegetation types as well as for some of the rarer types. However, the biophysical land classification is generalized over a larger area and several ecosites have been ascribed vegetation types which are unlikely to be found in the study corridor.

The following descriptions include only those vegetation types which are known to occur or are expected to occur in the study area. In the few instances where significant discrepancies between the field results and the biophysical land classification were noted, slight modifications to the vegetation descriptors and biophysical units have been made.

Montane Ecoregion - Athabasca 1 (AT1)

This ecosite develops on the coarse, calcareous glaciofluvial deposits of terraces on the floors and benchlands of broad valleys. Channeling may produce an irregular surface in some areas, while older surfaces often have a medium-textured aeolian veneer. The well to rapidly-drained soils are Orthic and Eluviated Eutric Brunisols.

Closed pine forests predominate with C3 (Pinus contorta/Juniperus communis/Arctostaphlyos uva-ursi), C6 (Pinus contorta/Shepherdia canadensis/Aster conspicuus/Hylocomium splendens), and C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis) most frequent.

Due to the prevalence of pine, this ecosite has a very low potential for rare species.

This ecosite occurs at one location in the study area (km 28).

Montane Ecoregion - Fireside 1 (FRI)

Coarse, calcareous fluvial deposits form fans and aprons in this unit. Well-drained Orthic and Eluviated Eutric Brunisols develop on the more stable surfaces, while active and abandoned channels have Orthic and Cumulic Regosols.

The closed forests are dominated by pine, and most frequently belong to C6 (Pinus contorta/Shepherdia canadensis/Aster conspicuus/Hylocomium splendens) and C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis) vegetation types. In Banff National Park, C9 (Pinus contorta/Vaccinium caespitosum/Hylocomium splendens) is restricted to terrain in and adjacent to the study area.

This ecosite has a very low potential for rare species due to the dominance of pine.

Fireside 1 is extensive near the mouth of Redearth Creek (km 36).

TABLE 3.4-1: PRINCIPAL VEGETATION TYPES ALONG EXISTING HIGHWAY

APPROXIMATE LOCATION (km)	ECOSITES	PRINCIPAL VEGETATION	RARE SPECIES POTENTIAL[2]
- North Side of Existing Alignment			
26.0 to 26.5	HD3	white spruce	L
26.5 to 27.5	VL3	white spruce, wetlands	H
27.5 to 28.0	PR2 (narrow)[1]/VL3	pine/white spruce, wetlands	VL/L
28.0 to 28.4	PR2 (narrow)/AT1	pine	VL
28.4 to 29.9	HD3	white spruce	L
29.9 to 30.5	PR2 (narrow)/VL3	pine/white spruce, wetlands	VL/L
30.5 to 31.0	VL3	white spruce, wetlands	L
31.0 to 31.1	IB1	pine	VL
31.1 to 31.2	VL3	white spruce, wetlands	L
31.2 to 31.6	IB1	pine	VL
31.6 to 31.8	VL3	white spruce, wetlands	L
31.8 to 31.9	IB1 (narrow)/VL3	pine/white spruce, wetlands	VL/L
31.9 to 33.4	IB1	pine	VL
33.4 to 33.8	PR2 (narrow)/VL3	pine/white spruce, wetlands	VL/L
33.8 to 33.9	VL3	white spruce, wetlands	L
33.9 to 34.0	FR1 (narrow)/VL3	pine/white spruce, wetlands	VL/L
34.0 to 37.5	FR1	pine	VL
37.5 to 38.0	VL3	white spruce, wetlands	L
38.0 to 38.4	FR1 (narrow)/VL3	pine/white spruce, wetlands	VL/L
38.4 to 39.0	BK4 (narrow)/VL3	pine, spruce/white spruce, wetlands	VL
39.0 to 39.8	VL3	white spruce, wetlands	M
39.8 to 40.4	AL1 (narrow)/VL3	pine/white spruce, wetlands	VL/L
40.4 to 40.9	VL3	white spruce, wetlands	L
40.9 to 42.2	PR6 (narrow)/VL3	pine/white spruce, wetlands	VL/L
42.2 to 43.4	IB1	pine	VL
43.4 to 43.9	BV1	pine	VL
43.9 to 44.1	BK4 (narrow)/HC1	pine/spruce, wetlands	VL/L
44.1 to 44.8	HC1	spruce, wetlands	L
44.8 to 45.4	AL1	pine	VL
45.4 to 46.3	BK4	pine	VL
46.3 to 46.4	HC1	spruce, wetlands	L
46.4 to 46.7	BK4	pine	VL
46.7 to 46.9	AL1	pine	VL
46.9 to 47.1	BK4	pine	VL
	HC1 (north of interchange)	spruce, wetlands	M
47.1 to 47.7	HC1	spruce, wetlands	L
47.7 to 53.3	BV1	pine	VL
53.3 to 53.4	AL1 (narrow)/BV1	pine	VL
53.4 to 54.8	BV1	pine	VL
54.8 to 55.1	VD2 (narrow)/BV1	pine	VL
55.1 to 55.7	BV1	pine	VL
55.7 to 56.7	AL1	pine	VL
56.7 to 58.6	BV1	pine	VL
58.6 to 61.1	AL1	pine, wetlands	M
61.1 to 62.4	BV1	pine	VL
62.4 to 63.0	VD2	pine	VL
63.0 to 63.6	VD2 (narrow)/HC1	pine/spruce, wetlands	VL/M
63.6 to 64.9	VD2	pine	VL
64.9 to 65.9	HC1	spruce, wetlands	L
65.9 to 69.4	BV1	pine	VL
69.4 to 70.1	VD2	pine	VL
70.1 to 71.2	PR6	pine	VL
Whitehorn			
73.4 to 74.0	BV1 (narrow)/BV2	pine	VL
74.0 to 74.2	BK4 (narrow)/BV2	pine	VL
74.2 to 74.6	BK4 (narrow)/BK1	pine	VL
74.6 to 75.5	BV1 (narrow)/BV2	pine	VL

1 The use of the term "narrow signifies that the unit forms a thin strip adjacent to the existing highway and another ecosite.

2 VL: very low; L: low; M: moderate; H: high

APPROXIMATE LOCATION (km)	ECOSITES	PRINCIPAL VEGETATION	RARE SPECIES POTENTIAL[2]
- South of Existing Alignment			
26.0 to 26.3	HD3 (narrow)/BY2	white spruce/spruce-fir	L
26.3 to 26.5	BY2	spruce-fir	L
26.5 to 27.5	BK1	pine	VL
27.5 to 28.6	PR2	pine	VL
28.6 to 28.9	HD3 (narrow)/PR2	white spruce/pine	L/VL
28.9 to 29.6	HD3	white spruce	L
29.6 to 29.9	HD3 (narrow)/PR2	white spruce/pine	L/VL
29.9 to 31.0	PR2	pine	VL
31.0 to 33.4	IB1	pine	VL
33.4 to 34.0	PR2	pine	VL
34.0 to 35.0	BK4	pine	VL
35.0 to 36.0	PR2	spruce	L
36.0 to 37.5	BK4	pine	VL
37.5 to 38.4	FR1 (narrow)/IB1	pine	VL
38.4 to 39.4	BK4	pine	VL
39.4 to 40.4	AL1	pine	VL
40.4 to 42.2	PR6	pine	VL
42.2 to 43.4	IB1	pine	VL
43.4 to 43.9	BK4	pine	VL
43.9 to 44.0	SB4	open forest, dry shrub, dry meadow	L
44.0 to 44.8	BK4 (narrow)/PR1	pine	VL
44.8 to 46.3	BK1	pine, spruce, wetlands	L
46.3 to 46.4	HC1 (narrow)/BK4	spruce, wetlands/pine	L/VL
46.4 to 46.7	BK4	pine	VL
46.7 to 46.9	AL1	pine	VL
46.9 to 47.1	BK4	pine	VL
47.1 to 47.8	HC1 (narrow)/BK4	spruce, wetlands/pine, spruce, wetlands	L
47.8 to 48.3	BK1	pine, spruce, wetlands	L
48.3 to 48.7	BV1 (narrow)/BK1	pine/pine, spruce, wetlands	VL/L
48.7 to 50.3	BV1	pine	L
50.3 to 50.5	BV1 (narrow)/BK1	pine	VL
50.5 to 51.3	BV1	pine	VL
51.3 to 51.5	BK1	pine, spruce, wetlands	L
51.5 to 51.7	BV1 (narrow)/BK1	pine	VL
51.7 to 52.2	BK1	pine	VL
52.2 to 52.8	BV1 (narrow)/VD2	pine	VL
52.8 to 53.3	BV1	pine	VL
53.3 to 53.5	AL1	pine, wetland	M
53.5 to 54.8	BV1	pine	VL
54.8 to 55.3	VD2	pine	VL
55.3 to 55.7	BK1	pine	VL
55.7 to 56.4	AL1	pine	VL
56.4 to 56.6	BK1	pine	VL
56.6 to 56.7	PR4	spruce-fir	L
56.7 to 57.7	BV1 (narrow)/PR4	pine/spruce-fir	VL/L
57.7 to 58.6	PR4	spruce-fir	L
58.6 to 61.2	AL1 (narrow)/PR4	pine/spruce-fir	VL/L
61.2 to 62.4	PR4	spruce-fir	L
62.4 to 62.9	VD2	pine	VL
62.9 to 63.3	VD2 (narrow)/PR4	pine/spruce-fir	VL/L
63.3 to 64.8	VD2	pine	VL
64.8 to 65.5	BK4	pine, spruce, wetlands	H
65.5 to 66.3	BV1	pine	VL
66.3 to 66.4	BV1 (narrow)/PR4	pine/spruce-fir	VL/L
66.4 to 68.4	BV1	pine	VL
68.4 to 69.0	BV1 (narrow)/PR4	pine/spruce-fir	VL/L
69.0 to 69.4	BV1 (narrow)/VD1	pine/spruce-fir	VL/L
69.4 to 70.1	VD2	pine	VL
70.1 to 71.2	PR6 (narrow)/VD2	pine	VL
Whitehorn			
73.4 to 73.6	BV1	pine	VL
73.6 to 74.0	BV1 (narrow)/BK4	pine/pine, spruce, wetlands	VL/L
74.0 to 74.6	BK4	pine, spruce, wetlands	M
74.6 to 75.5	BV1	pine	VL

Montane Ecoregion - Hillsdale 3 (HD3)

Although the parent material is similar to that of Fireside 1, this ecosite is subject to episodic flooding which leaves interbedded and admixed humus. Consequently, Orthic and Cumulic Regosols predominate except on elevated areas where Orthic Eutric Brunisols have developed.

Spruce predominates on these sites; C5 (Picea glauca/Hylocomium splendens) is the most common vegetation type.

The presence of moist spruce forests gives this ecosite a slightly higher potential for rare species than pine forests; however, the potential remains low.

Hillsdale 3 occurs within the first four kilometres past the Sunshine Junction (km 26 & 29).

Montane Ecoregion - Vermilion Lakes 3 (VL3)

This ecosite includes both fluvial and glaciofluvial calcareous materials and is not as extensively ponded as Vermilion Lakes 1 (does not occur within the proposed alignment). Most soils are Rego Gleysols; however, Gleyed Cumulic Regosols and Terric Mesisols also occur.

Many vegetation types have been found in this imperfectly to poorly drained unit. C4 (Picea glauca/Rosa acicularis/Equisetum arvense) is most widespread, along with S1 (Betula spp.-Potentilla fruticosa-Salix glauca/Carex aquatilis-Deschampsia caespitosa/Tomenthypnum nitens-Aulacomnium palustre-Drepanocladus revolvens) and S7 (Salix spp./Equisetum arvense).

Less abundant types include O3 (Picea glauca/Potentilla fruticosa/Arctostaphylos uva-ursi), S3 (Betula glandulosa-Potentilla fruticosa/Scirpus caespitosus-Carex aquatilis/Drepanocladus revolvens-Tomenthypnum nitens), and H11 (Carex aquatilis-Carex rostrata).

The presence of spruce and a diversity of wetlands gives this ecosite a good potential for rare species. The spruce types can be categorized as having a low potential. The wetlands are highly variable and the potential ranges from low and medium for most sites and to high for sites containing S3 or related vegetation. Lower ratings are generally ascribed to H11 and related types.

Vermilion Lakes 3 can be found between the Trans-Canada Highway and the Bow River from the Sunshine Junction to the banks opposite Johnson Creek (km 27 to 42).

Lower Subalpine Ecoregion - Ishbel 1 (IB1)

Stabilized, hummocky landslides occur in this ecosite. The variably-textured calcareous and non-calcareous materials contain a high proportion of coarse fragments, and develop into Orthic and Eluviated Eutric Brunisols on calcareous sites and Eluviated Dystric Brunisols on non-calcareous sites.

Mesic pine forests are most common, including C18 (Pinus contorta/Shepherdia canadensis/Vaccinium scoparium), C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis) and C29 (Pinus contorta/Ledum groenlandicum).

Due to the predominance of pine, this ecosite is given a very low rare species potential.

Ishbel 1 is found about five km northwest of the Sunshine Junction, near Redearth Creek, and across from the mouth of Johnson Canyon (km 32, 38, and 43).

Lower Subalpine Ecoregion (Calcareous) - Altrude 1 (AL1)

Coarse-textured fluvial fans and aprons, often marked by active and abandoned channels, typify this ecosite. Most soils are either Orthic or Eluviated Eutric Brunisols. The type is widespread along lower slopes and valley floors of the Bow River and its major tributaries.

Simple, closed pine forests predominate, particularly C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis), C6 (Pinus contorta/Shepherdia canadensis/Aster conspicuus/Hylocomium spendens), C18 (Pinus contorta/Shepherdia canadensis/Vaccinium scoparium/Hylocomium splendens) and C9 (Pinus contorta/Shepherdia canadensis/Vaccinium caespitosum).

Some minor wetlands are also found in this ecosite.

There is a very low rare species potential due to the prevalence of pine; however, there are scattered wetlands within this unit which have a moderate rare species potential.

Altrude 1 sites can be found in several locations from km 33 to 61.

Lower Subalpine Ecoregion (Calcareous) - Baker Creek 1 (BK1)

This medium-textured till unit usually has a complex topography of strong slopes, due to bedrock control or morainal knolls. The bowl-shaped depressions are often mantled with fen peat. Eluviated Eutric Brunisols dominate on uplands, with Rego Gleysols and Terric Mesisols in lowlands.

The dry/wet pattern creates considerable vegetation heterogeneity. The uplands are mainly forested with pine consisting of C18 (Pinus contorta/Shepherdia canadensis/Vaccinium scoparium/Hylocomium splendens), C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis) and C29 (Pinus contorta/Ledum groenlandicum) types. C6 (Pinus contorta/Shepherdia canadensis/Aster conspicuus) is found at low elevations.

Wetlands are rare in the study area but, potentially, have a variety of vegetation types, with S1 (Betula spp.-Potentilla fruticosa-Salix glauca/Carex aquatilis-Deschampsia caespitosa/Tomenthypnum nitens-Aulacomnium palustre-Drepanocladus revolvens) most common. O11 (Picea/Ledum groenlandicum-Betula glandulosa/Carex aquatilis/Tomenthypnum nitens and Sphagnum fuscum) and S3 (Betula glandulosa-Potentilla fruticosa/Scirpus caespitosus-Carex aquatilis/Drepanocladus revolvens-Tomenthypnum nitens) are also present.

Minor types include O6 (Picea engelmannii-Abies lasiocarpa/Salix spp./Aulacomnium palustre) and H11 (Carex aquatilis-Carex rostrata).

There is a very low potential for rare species due to the predominance of pine. Wetlands range from low to high in their potential for rare species, although no sites were specifically identified in this study.

The ecosite is widespread on benchlands above the Bow River throughout the study area.

Lower Subalpine Ecoregion (Calcareous) - Baker Creek 4 (BK4)

The soils and topography of this ecosite resemble those of BK1, however, the genetic material is ice-contact drift. The vegetation of uplands and wetlands closely resembles that of the previous Baker Creek 1 ecosite.

There is a very low potential for rare species in the pine woodland. The potential in open spruce and wetlands ranges from low to high; one high potential site was noted during this study.

This ecosite is also widespread on benchlands above the Bow River throughout the study area.

Lower Subalpine Ecoregion (Calcareous) - Bow Valley 1 (BV1)

This unit develops on glaciofluvial terraces of coarse-textured materials. Isolated bedrock knolls rise above these deposits in an unusual landscape between Moraine and Paradise Creeks.

Closed pine forests on Orthic and Eutric Brunisols are similar to those of AL1 ecosites. C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis), C18 (Pinus contorta/Shepherdia canadensis/Vaccinium scoparium/Hylocomium splendens) and C9 (Pinus contorta/Shepherdia canadensis/Vaccinium caespitosum) predominate. C3 (Pinus contorta/Juniperus communis/Arctostaphylos uva-ursi) also occurs on drier sites.

The extensive pine forests have a very low potential for rare species.

Extensive areas of the ecosite occur between Altrude Creek to the Icefields Parkway Junction (km 48 to 75).

Lower Subalpine Ecoregion (Calcareous) - Bow Valley 2 (BV2)

Although the landforms and soils of this unit are similar to those of the previous (BV1), there are subtle differences in the prevailing pine vegetation which consists primarily of C20 (Pinus contorta/Menziesia glabella/Vaccinium scoparium/Hylocomium splendens) and C29 (Pinus contorta/Ledum groenlandicum).

There is a very low potential for rare species in these pine woodlands.

Within the study area, the ecosite occurs only near the Icefields Parkway junction (km 74 to 75).

Lower Subalpine Ecoregion (Calcareous) - Bryant 2 (BY2)

This ecosite occurs on calcareous, medium-textured till blankets overlying inclined bedrock on valley walls, shoulders and floors. The long linear slopes are often dissected by subparallel ravines, and may include small fluvial fans and aprons at their base. Seeps occur in some gullies and depressions. The single unit in our study area is a lithic phase, in which only a shallow till veneer overlies bedrock. The dominant soils are well-developed Eluviated and Orthic Eutric Brunisols which grade into Gray Luvisols and Humo-Ferric Podzols.

Closed spruce-fir forests dominate, including C13 (Picea engelmannii-Abies lasiocarpa/Hylocomium splendens) and C30 (Picea engelmannii-Abies lasiocarpa/Ledum groenlandicum/Empetrum nigrum/feather moss).

Small patches of C14 (Picea engelmannii-Abies lasiocarpa/Menziesia glabella/Vaccinium scoparium/Hylocomium splendens) may occur on north aspects.

These moist spruce-fir forests have a low potential for rare species.

There is only one area of this ecosite in the study area, south of the Trans-Canada Highway immediately west of the Sunshine Junction (km 26).

Lower Subalpine Ecoregion (Calcareous) - Hector 1 (HC1)

This ecosite occurs on wet fluvial fans and aprons, where coarse calcareous materials predominate, with local, non-calcareous inclusions. Active and abandoned channels are widespread, while organic deposits accumulate in more stagnant environments.

Terric Mesisols dominate on thin peat deposits, while Rego Gleysols and Gleyed Cumulic Regosols, showing varying degrees of gleying, develop on mineral substrates.

The wet sites support a variety of vegetation types, mostly notably closed forests of C32 (Picea engelmannii/Equisetum arvense/Hylocomium splendens) on the best drained sites, and open forests of O6 (Picea engelmannii-Abies lasiocarpa/Salix glauca/Carex vaginata-Carex aquatilis/Aulacomnium palustre-Tomenthypnum nitens) in wetter areas.

Frequent small patches of S1 (Betula spp.-Potentilla fruticosa-Salix glauca/Carex aquatilis-Deschampsia caespitosa/Tomenthypnum nitens-Aulacomnium palustre-Drepanocladus revolvens) and S3 (Betula glandulosa-Potentilla fruticosa/Scirpus caespitosus-Carex aquatilis/Drepanocladus revolvens-Tomenthypnum nitens) break up the forests.

Other minor vegetation types include C13 (Picea engelmannii-Abies lasiocarpa/Hylocomium splendens), C30 (Picea engelmanii-Abies lasiocarpa/Ledum groenlandicum/Empetrum nigrum/Hylocomium splendens), C29 (Pinus contorta/Ledum groenlandicum), O11 (Picea/Ledum groenlandicum-Betula glandulosa/Carex aquatilis/Tomenthypnum nitens-Sphagnum fuscum), O3 (Picea glauca/Potentilla fruticosa/Arctostaphylos uva-ursi), H3 (Carex scirpoidea-Saxifraga aizoides), H8 (Dryas drummondii-Epilobium latifolium) and H11 (Carex aquatilis-Carex rostrata).

The moist spruce woodlands have a low potential for rare species, while the potential in the wetlands and minor vegetation types ranges from low to moderate.

This ecosite occurs along the Bow River near the mouths of Altrude and Moraine Creeks (km 45 and 63).

Lower Subalpine Ecoregion (Calcareous) - Panorama Ridge 1 (PR1)

Panorama Ridge Units are underlain by medium-textured glacial materials. The Panorama Ridge 1 ecosite is marked by morainal blankets overlying bedrock of the valley walls. The long, linear slopes are often dissected by subparallel gullies. Orthic and Eluviated Eutric Brunisols dominate, along with less extensive Brunisolic Gray Luvisols. Lithic phases occur in parts of the study area.

Pine woods consisting of C20 (Pinus contorta/Menziesia glabella/Vaccinium scoparium/Hylocomium splendens) and C29 (Pinus contorta/Ledum groenlandicum) are most common.

Due to the predominance of pine, this ecosite has a very low potential for rare species.

Panorama Ridge 1 sites occur above the Trans-Canada Highway opposite Castle Mountain (km 44).

Lower Subalpine Ecoregion (Calcareous) - Panorama Ridge 2 (PR2)

These areas are geomorphically similar to PR1, but have slightly different vegetation.

C6 (Pinus contorta/Shepherdia canadensis/Aster conspicuus/Hylocomium splendens), C18 (Pinus contorta/Shepherdia canadensis/Vaccinium scoparium/Hylocomium splendens), and C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis) are most common, reflecting frequent fires.

C29 (Pinus contorta/Ledum groenlandicum), C3 (Pinus contorta/Juniperus communis/Arctostaphylos uva-ursi), and C20 (Pinus contorta/Menziesia glabella/Vaccinium scoparium) also occur.

The pine forests have a very low potential for rare species.

Panorama Ridge 2 occurs from km 28 to 34 on slopes above the Bow River.

Lower Subalpine Ecoregion (Calcareous) - Panorama Ridge 4 (PR4)

These areas have calcareous, variously-textured ice-contact deposits as well as the medium-textured till found in the two previous types. Orthic and Eluviated Eutric Brunisols predominate.

Picea englemannii types dominate the vegetation of this ecosite in the study area. More specifically, C13 (Picea engelmannii-Abies lasiocarpa/Hylocomium splendens) and C14 (Picea engelmannii-Abies lasiocarpa/Menziesia glabella) are characteristic, along with many related types. C20 (Pinus contorta/Menziesia glabella/Vaccinium scoparium) is one of several seral communities which occur. The moist spruce-fir forests have a low potential for rare species.

The Panorama Ridge 4 ecosite occurs on slopes above the Bow River in the northern portion of the study area (km 57 to 69).

Lower Subalpine Ecoregion (Calcareous) - Panorama Ridge 6 (PR6)

Unlike other Panorama Ridge types, this unit occurs only on variably-textured ice-contact materials. Slopes are strong (15-30%) and complex, due either to depositional features such as kames, eskers and kettles, or to bedrock control.

Soils tend to be Eluviated Eutric Brunisols, with more poorly developed Orthic Eutric Brunisols and better developed Brunisolic Gray Luvisols subdominant.

Pine forests predominate, including C18 (Pinus contorta/Shepherdia canadensis/Vaccinium scoparium/Hylocomium splendens), C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis) and C29 (Pinus contorta/Ledum groenlandicum).

C3 (Pinus contorta/Juniperus communis/Arctostaphylos uva-ursi) may occur on drier, less stable slopes and C6 (Pinus contorta/Shepherdia canadensis/Aster conspicuus) are found at low elevations.

There is a low potential for rare species in these pine woodlands.

Panorama Ridge 6 occurs in two locations, one across from Johnson Creek (km 41) and the other just south of the Whitehorn Interchange (km 70).

Lower Subalpine Ecoregion (Calcareous) - Sawback 4 (SB4)

This diverse ecosite occurs on discontinuous colluvial veneers and blankets of coarse, calcareous materials overlying inclined bedrock, with secondary avalanching in areas.

The distribution of soils reflects the degree of surface colluviation and avalanching. Orthic Eutric Brunisols predominate, with Orthic Regosols and Orthic Humic Regosols where geomorphic removal or accretion is intense.

The vegetation of avalanched areas comprises a patchwork of closed and open forests. These include C3 (Pinus contorta/Juniperus communis/Arctostaphylos uva-ursi) and O17 (Picea glauca/Juniperus communis/Arctostaphylos uva-ursi).

There is a low potential for rare species in this ecosite.

In the study area, this ecosite is represented only at km 44.

Lower Subalpine Ecoregion (Non-calcareous) - Verdant 1 (VD1)

This type occurs on coarse material on relatively stable fluvial fans and aprons. Soils are well to moderately well-drained Orthic and Eluviated Dystric Brunisols, with the latter dominant. The ecosite occurs at the mouth of Paradise Creek.

Closed spruce-fir forests cover this area with C13 (Picea engelmannii-Abies lasiocarpa/Hylocomium splendens) most prominent.

The spruce-fir forests have a low potential for rare species.

There is only one Verdant 1 site within the study area, at km 69.

Lower Subalpine Ecoregion (Non-calcareous) - Verdant 2 (VD2)

These sites are similar in soils and landforms to the previous type (VD1), however, pine forests predominate. C19 (Pinus contorta/Shepherdia canadensis/Linnaea borealis), and C9 (Pinus contorta/Shepherdia canadensis/Vaccinium caespitosum) are generally common.

The pine forests have a very low potential for rare species.

The ecosite occurs at creek mouths between Altrude and Moraine Creeks (km 53, 55, and 64).

3.4.2 SIGNIFICANT VEGETATION LOCATIONS

In marked contrast to the vegetation in Phases I and II of the TCH Improvements (Woodland Resource Services 1984; Public Works Canada 1981; Western Ecological Services 1981) in the Park, the Phase III study area has fewer and smaller highly significant vegetation locations within the proposed new alignment or immediately adjacent to it. This relates principally to the lack of open Montane grassland and Douglas fir vegetation in the Phase III area.

Much of the area is occupied by closed forest with low to very low potential for rare species. The most significant sites listed below and shown on Figure 3.4-1 are calcareous seepage and wetland vegetation along portions of the floodplain and on the slopes.

(1) km 26.5 to 26.8 (north side)
Strongly calcareous wetlands within a wetland VL3 unit (high rare species potential)

(2) km 39.0 to 39.3 (north side)
Aquatic emergent vegetation within a wetland VL3 unit (moderate rare species potential)

(3) km 47.0 (north of existing Castle Interchange)
Calcareous seepage and channels within a HC1 unit (moderate rare species potential)

(4) km 53.6 (south side)
Exposed mudflats, aquatic vegetation in AL1 unit (moderate rare species potential)

(5) km 58.9 to 59.1 (north side)
Calcareous seepage and channels in an AL1 unit (moderate rare species potential)

(6) km 62.9 to 63.0 (north side)
Calcareous seepage and channel in a HC1 unit (moderate rare species potential)

(7) km 64.9 to 65.4 (south side)
Strongly calcareous wetlands within a BK4 unit (high rare species potential)

(8) km 74.3 (south side)
Wetland with aquatic emergent vegetation (moderate rare species potential)

The following significant dry upland vegetation types were identified:

(9) km 69.2 (south side)
Area of lichen-covered boulders (low rare species potential; represents rare vegetation community in Bow Valley corridor)

(10)km 70.1 (north side)
Steep grass/bearberry/juniper slope (moderate rare species potential)

All of these sites lie close to or within the proposed improvements.

3.4.3 POTENTIAL SIGNIFICANT SPECIES

The following list of significant species which may occur in the study area was constructed from lists provided by Achuff & Corns (1982) and Packer & Bradley (1984), and from interviews with P. Achuff.

Arnica longifolia
Aster maccallae
Botrychium spp.
Carex interior
Carex lenticularis
Carex limnophila
Castilleja hispida
Cypripedium calceolus
Drosera spp.
Ledum glandulosum
Lilium philadelphicum
Listera spp.
Osmorhiza spp.
Parnassia parviflora
Primula mistassinica
Smilacina trifolia
Salix myrtillifolia

TABLE 3.4-2: DESCRIPTION OF VEGETATION TYPES ALONG ROUTE OF PROPOSED IMPROVEMENTS

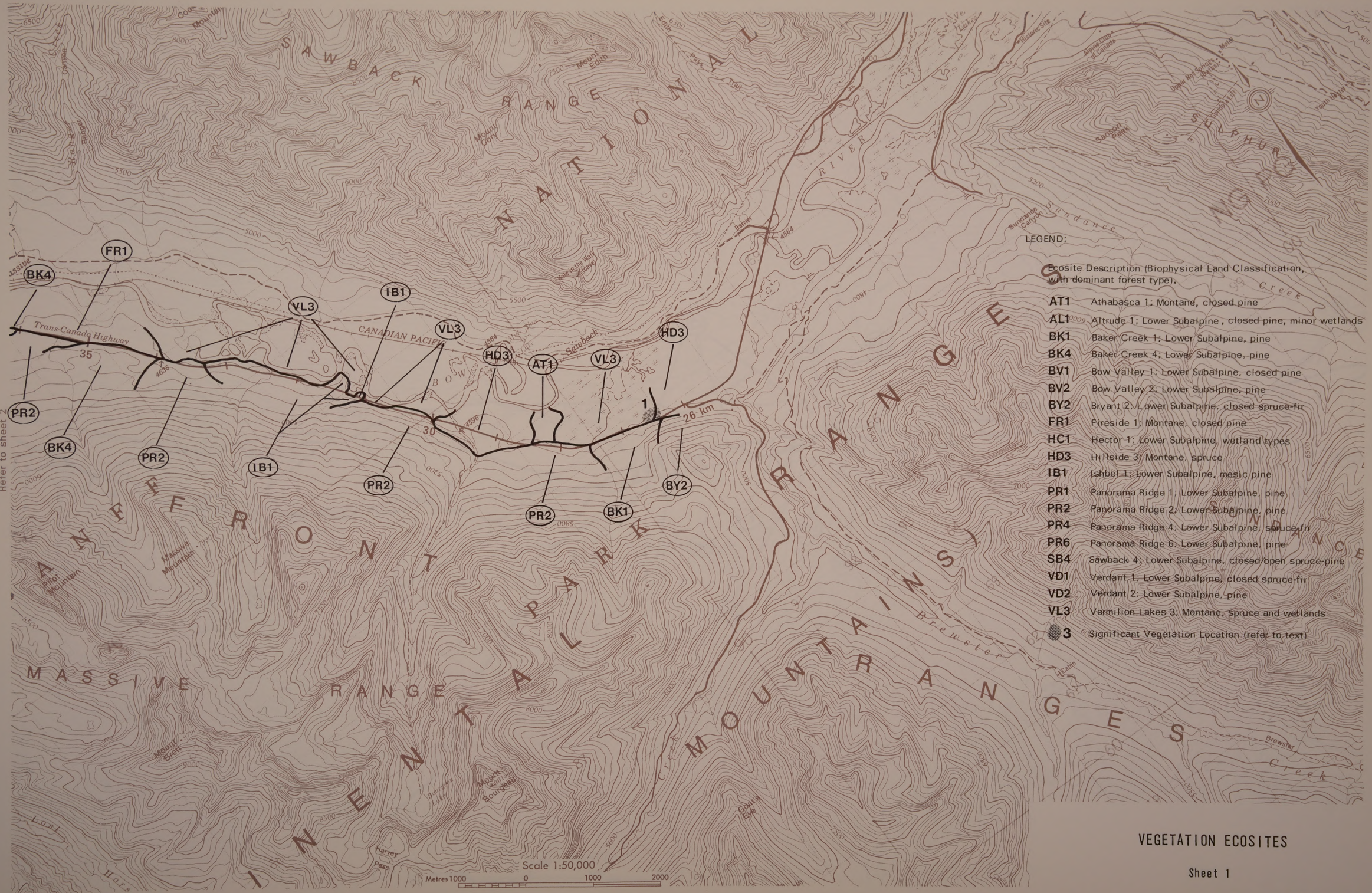
CLOSED FOREST VEGETATION							
TYPE NO.	C3	C4	C5	C6	C9	C13	C14
NAME	Pinus contorta Juniperus communis Arctostaphylosuva-ursi	Picea glauca Rosa acicularis Equisetum arvense	Picea glauca Pseudotsuga menziesii Hylocomium splendens	Pinus contorta Shepherdia canadensis Aster conspicuus	Pinus contorta Vaccinium caespitosum	Picea engelmannii Abies lasiocarpa Hylocomium splendens	Picea engelmannii Abies lasiocarpa Menziesia glabella Vaccinium scoparium
SHORT NAME	lodgepole pine juniper bearberry	white spruce prickly rose horsetail	white spruce Douglas fir feathermoss	lodgepole pine buffaloberry showy aster	lodgepole pine dwarf bilberry	Engelmann spruce subalpine fir feathermoss	Engelmann spruce subalpine fir false azalea
CHARACTERISTIC SPECIES	Pinus contorta Juniperus communis Shepherdia canadenis Arctostaphylos uva-ursi Elymus innovatus Linnaea borealis	Picea glauca Rosa acicularis Equisetum arvense Hylocomium splendens	Picea glauca Pseudotsuga menziesii Hylocomium splendens	Pinus contorta Shepherdia canadensis Rosa acicularis Aster conspicuus Elymus innovatus Calamagrostis rubescens Hylocomium splendens Pleurozium schreberi	Pinus contorta Vaccinium caespitosum Linnaea borealis Elymus innovatus Calamagrostis rubescens Pleurozium schreberi	Picea engelmannii Abies lasiocarpa Hylocomium splendens Pleurozium schreberi Ptilium crista-castrensis	Picea engelmannii Abies lasiocarpa Menziesia glabella Vaccinium scoparium Linnaea borealis Pleurozium schreberi Hylocomium splendens
NOTES	Common on gentle to steep upland slopes; very low potential for rare species	Common floodplain vegetation type; low potential for rare species	Occasionally occurs on slopes; no Douglas fir noted in study area types; low potential for rare species	Common on slopes; very low potential for rare species	Restricted in Banff National Park to the vicinity of the study area, (on nearly level terrain); very low potential for rare species	Common on steep and gentle slopes; low potential for rare species	Common on steep to gentle slopes; low potential for rare species

CLOSED FOREST VEGETATION						
TYPE NO.	C18	C19	C20	C29	C30	C32
NAME	Pinus contorta Shepherdia canadensis Vaccinium scoparium	Pinus contorta Shepherdia canadensis Linnaea borealis	Pinus contorta Menziesia glabella Vaccinium scoparium	Pinus contorta Ledum groenlandicum	Picea engelmannii Abies lasiocarpa Ledum groenlandicum Empetrum nigrum	Picea engelmannii Equisetum arvense Hylocomium splendens
SHORT NAME	lodgepole pine buffaloberry grouseberry	lodgepole pine buffaloberry grouseberry	lodgepole pine false azalea grouseberry	lodgepole pine Labrador tea	Engelmann spruce subalpine fir Labrador tea crowberry	Engelmann spruce horsetail feathermoss
CHARACTERISTIC SPECIES	Pinus contorta Shepherdia canadensis Vaccinium scoparium Elymus innovatus Linnaea borealis Pleurozium schreberi Hylocomium splendens	Pinus contorta Shepherdia canadensis Linnaea borealis Elymus innovatus Calamagrostis rubescens Hylocomium splendens Pleurozium schreberi	Pinus contorta Menziesia glabella Vaccinium scoparium Pleurozium schreberi Hylocomium splendens	Pinus contorta Picea spp. Ledum groenlandicum Vaccinium scoparium Pleurozium schreberi Hylocomium splendens Ptilium crista-castrensis	Picea engelmannii Abies lasiocarpa Ledum groenlandicum Empetrum nigrum Vaccinium scoparium Hylocomium splendens Pleurozium schreberi Ptilium crista-castrensis	Picea engelmannii Equisetum arvense Hylocomium splendens Pleurozium schreberi
NOTES	Common on slopes; very low potential for rare species	Common on drier upland slopes; very low potential for rare species	Occasional on slopes; very low potential for rare species	Occasionally occurs on north-facing slopes; very low potential for rare species	Occasionally occurs on north-facing slopes; low potential for rare species	Occasionally occurs on slopes; low potential for rare species

TABLE 3.4-2: DESCRIPTION OF VEGETATION TYPES ALONG ROUTE OF PROPOSED IMPROVEMENTS

	OPEN FOREST VEGETATION				SHRUB VEGETATION		
TYPE NO.	03	06	011	017	S1	S3	S7
NAME	Picea glauca Potentilla fruticosa Arctostaphylos uva-ursi	Picea engelmannii Abies lasiocarpa Salix spp. Aulacomnium palustre	Picea spp. Ledum groenlandicum Tomenthypnum nitens	Picea glauca Juniperus communis Arctostaphylos uva-ursi	Betula spp. Potentilla fruticosa Tomenthypnum nitens	Betula glandulosa Potentilla fruticosa Scirpus caespitosus Drepanocladus revolvens	Salix spp. Equisetum arvense
SHORT NAME	white spruce shrubby cinquefoil bearberry	Engelmann spruce subalpine fir willow ribbed bog moss	spruce Labrador tea brown moss	white spruce juniper bearberry	dwarf birch- shrubby cinquefoil willow brown moss	dwarf birch shrubby cinquefoil needlerush	willow horsetail
CHARACTERISTIC SPECIES	Picea glauca Potentilla fruticosa Shepherdia canadensis Arctostaphylos uva-ursi Elymus innovatus	Picea engelmannii Abies lasiocarpa Salix glauca Betula glandulosa, Potentilla fruticosa Carex vaginata Carex aquatilis Equisetum arvense Aulacomnium palustre Tomenthypnum nitens	Picea spp. Ledum groenlandicum Betula glandulosa Carex aquatilis Equisetum arvense Tomenthypnum nitens Aulacomnium palustre Sphagnum fuscum	Picea glauca Juniperus communis Shepherdia canadensis Arctostaphylos uva-ursi Elymus innovatus	Betula spp. Salix glauca Potentilla fruticosa Carex aquatilis Deschampsia caespitosa Tomenthypnum nitens Drepanocladus revolvens Aulacomnium palustre Campylium stellatum	Betula glandulosa Potentilla fruticosa Scirpus caespitosus Carex aquatilis Drepanocladus revolvens Tomenthypnum nitens	Salix glauca Salix planifolia Salix bebbiana Salix farrae Equisetum arvense
NOTES	Occasional vegetation type; low potential for rare species	Occasionally occurs on moist slopes; moderate potential for rare species	Common wetland vegetation type; low to moderate potential for rare species	Occasionally occurs on dry slopes; low potential for rare species	Common wetland vegetation type; low potential for rare species	Uncommon wetland vegetation type; moderate to high potential for rare species	Occasional wetland vegetation type on floodplains; low to moderate potential for rare species

	HERB VEGETATION		
TYPE NO.	H3:	H8	H11
NAME	Carex scirpoidea Saxifraga aizoides	Dryas drummondii Epilobium latifolium	Carex aquatilis Carex rostrata
SHORT NAME	sedge saxifrage	yellow dryad willow herb	water sedge beaked sedge
CHARACTERISTIC SPECIES	Carex scirpoidea Saxifraga aizoides Anemone parviflora	Dryas drummondii Salix brachycarpa Shepherdia canadensis Arctostaphylos uva-ursi Epilobium latifolium	Carex aquatilis Carex rostrata Equisetum fuviatile Drepanocladus revolvens Tomenthypnum nitens
NOTES	Occasionally occurs along stream channels; numerous calcicoles occupy this habitat; moderate to high potential for rare species	Commonly occurs along gravelly stream channels; low potential for rare species	Common wetland vegetation type, principally on floodplains; low potential for rare species



LEGEND:

Ecosite Description (Biophysical Land Classification, with dominant forest type).

AT1	Athabasca 1; Montane, closed pine
AL1	Altrude 1; Lower Subalpine , closed pine, minor wetlands
BK1	Baker Creek 1; Lower Subalpine, pine
BK4	Baker Creek 4; Lower Subalpine, pine
BV1	Bow Valley 1; Lower Subalpine, closed pine
BV2	Bow Valley 2; Lower Subalpine, pine
BY2	Bryant 2; Lower Subalpine, closed spruce-fir
FR1	Fireside 1; Montane, closed pine
HC1	Hector 1; Lower Subalpine, wetland types
HD3	Hillside 3; Montane, spruce
IB1	Ishbel 1; Lower Subalpine, mesic pine
PR1	Panorama Ridge 1; Lower Subalpine, pine
PR2	Panorama Ridge 2; Lower Subalpine, pine
PR4	Panorama Ridge 4; Lower Subalpine, spruce-fir
PR6	Panorama Ridge 6; Lower Subalpine, pine
SB4	Sawback 4; Lower Subalpine, closed/open spruce-pine
VD1	Verdant 1; Lower Subalpine, closed spruce-fir
VD2	Verdant 2; Lower Subalpine, pine
VL3	Vermilion Lakes 3; Montane, spruce and wetlands
3	Significant Vegetation Location (refer to text)

VEGETATION ECOSITES

Sheet 1

FIGURE 3.4-1

VEGETATION ECOSITES

Sheet 2

FIGURE 3.4-1

VEGETATION ECOSITES

Sheet 3

FIGURE 3.4-1

SECTION 3.5

FISH RESOURCE

3.5.1 CHARACTERISTICS OF LOCAL FISH SPECIES

The portion of the Bow River system in the study area lies upstream of Bow Falls, located at Banff. The Phase I EIS includes an unsubstantiated report that these falls constitute an upstream migrational barrier to fish. Fish species historically present in the study area include longnose sucker (Catostomus catostomus), white sucker (C. commersoni), bull trout (Salvelinus confluentus - formerly known as Dolly Varden char, S. malma), eastern brook trout (S. fontinalis), lake trout (S. namaycush), Arctic char (S. alpinus, also referred to as Quebec red trout), splake (S. fontinalis X S. namaycush), cutthroat trout (Salmo clarki), rainbow trout (S. gairdneri), brown trout (S. trutta), mountain whitefish (Prosopium williamsoni), longnose dace (Rhinichthys cataractae) and brook stickleback (Culaea inconstans) (Rawson, 1939; Ward, 1974).

Records indicate that game and non-game fish species have been stocked in the Park since the late 1800s. Most lakes have been planted with one to three species of fish. Multiple fish species stocking in the study area has been largely confined to Lake Louise and Vermilion Lakes. Lake Louise has been planted with Arctic char, mountain whitefish, bull trout, splake, eastern brook trout, cutthroat trout and rainbow trout. Vermilion Lakes has been the recipient of more species, having been planted with longnose sucker, brook stickleback, brown trout, mountain whitefish, cutthroat trout, eastern brook trout, rainbow trout, bull trout and splake. The most widespread planting has been carried out with cutthroat trout, eastern brook trout and rainbow trout. For example, in the Bow River drainage above the falls, cutthroat trout have been planted in approximately 41 lakes (Ward, 1974;).

Within the study area, headwater lakes on at least five tributary streams have been planted with fish. These are: Moraine Creek - bull trout, splake and cutthroat trout; Altrude Creek - mountain whitefish, eastern brook trout and cutthroat trout; Taylor Creek - cutthroat trout; Redearth Creek - eastern brook trout and cutthroat trout; Smith Lake - eastern brook trout and cutthroat trout.

Recent fisheries investigations, conducted upstream of Bow Falls, not surprisingly indicate the wide variety but relative abundance of only certain species in the study area. Mudry and Green (1977) captured approximately equal numbers of eastern brook trout and bull trout from the Brewster Creek drainage. Underwood McLellan Ltd. (1985) captured eastern brook trout and mountain whitefish (in a ratio of about 3:1), from Altrude Creek but report that this stream has also been utililzed by cutthroat trout, bull trout and longnose sucker. A study of streams in the Lake Louise area (Mayhood et al., 1976) found eastern brook trout and cutthroat trout were encountered frequently; bull trout comprised only ten percent of the catch. Similar low proportions of bull trout in biological collections have been reported by Slaney (1976) for this area. Only one specimen of mountain whitefish was captured by Mayhood et al. (1976), whereas this species comprised ten percent of fish collected by Slaney (1976). The statements by Ward (1974) that bull trout are abundant in the mountain parks and by Rawson (1939) that mountain whitefish is the most abundant species in the Bow River may no longer be the case for the study area.

During the limited studies conducted for this I.A. eastern brook trout were found to be most widespread, whereas cutthroat trout and mountain whitefish were rarely encountered (Table 3.5-2). The sampling was confined to a single sampling period and, therefore, is not representative of the potential seasonal usage of streams by each species.

The Phase II EIS provides a more detailed presentation of fish distribution in the Park and fish life history information for streams just downstream of the study area. The reader is referred to this document for more detailed information.

3.5.2 WATER QUALITY

Water quality information on the study area is limited. Robinson and Smith (1974) conducted some work on the Bow and Pipestone rivers near Lake Louise but concentrated on parameters associated with sewage discharges. A more extensive characterization of the water of the Bow River was undertaken at two sites by Environment Canada (1984). One site was located at the TCH bridge above Lake Louise, and the other about 4.5 km above Canmore. At the Lake Louise site the river is low in nutrients (total phosphorus usually less than 3 ug $P \cdot L^{-1}$ and total nitrogen usually below 150 ug $N \cdot L^{-1}$), low in total coliform bacteria (below detection limits), with metals being at or below detection levels, turbidity reaching 5.4 JTU, pH of approximately 8.0, and low to moderate hardness that was usually approaching 100 $mg \cdot L^{-1}$. This water quality is representative of a relatively undisturbed east slope headwater stream. Water quality found at the Canmore site was substantially different. These data show that nutrients had increased (total phosphorus usually near 10 ug $P \cdot L^{-1}$, total nitrogen approximately 200 ug $N \cdot L^{-1}$), elevated total coliform bacteria (detectable at all times reaching 4300 MPN), pH remained near 8.0, metals also remained low downstream, hardness was moderate (usually above 160 $mg \cdot L^{-1}$) and turbidity reached 8.5 JTU. In addition, ions (K, Na, F, SiO_2, SO_4, Mg and Ca) were elevated. Extensive organic chemical analyses were also conducted at the downstream site, however all results were at or below detection limits.

Other streams in the study area are generally low nutrient, slightly alkaline owing to the calcareous geology of the area. These streams are usually clear except during high flow periods which begin with snowmelt in the spring and extend from approximately May into August.

3.5.3 USE OF STREAMS CROSSED BY HIGHWAY

The following discussion on fish usage in streams expected to be crossed or encroached upon by the project includes all streams with fish bearing potential. These were sampled to establish fish presence (Tables 3.5-1 and 3.5-2). Although not provided in this report, site specific aquatic biophysical data were also collected. Fish sampling sites, species captured and aquatic biophysical data collection sites are shown on Figure 3.5-1.

Bow River Wetland (km 27.5)

This wetland area is a series of relatively shallow, beaver controlled ponds. The ponds are well removed from the mainstem Bow River and the lack of fish suggests the area is probably not accessible to fish.

Bow River Wetland (km 30.0)

This wetland area is a series of deep (1-2 m), silt laden, beaver controlled ponds. Extensive instream cover is provided by aquatic vegetation. Instream debris, crown and overhang provide moderate cover. Fish sampling yielded a dense population of yearling and older eastern brook trout. Spawning habitat appeared to be quite limited.

Redearth Creek (km 37.4)

Redearth Creek is the largest stream in the study area. It is characterized by a wide channel and relatively deep, fast flowing riffles over cobble and boulder substrate. Spawning habitat is limited since suitable gravel deposits occur only behind large boulders. Rearing is confined to a few low velocity margin areas among cobbles and boulders. Fish sampling yielded a sparse population of eastern brook trout.

A 4 m high falls, considered impassable to fish migrating upstream, is located approximately 250 m upstream of the existing highway. However, eastern brook trout and cutthroat trout have been planted above the falls.

Bow River Backwater (km 40.8)

This backwater of the Bow River is impinged upon by the present highway. It is blocked at the upstream end by a rock dyke, but has a shallow outflow channel 4 m wide which provides access for fish. The backwater is approximately 700 m long, 20-70 m wide, has depths ranging from 0.5 - 2 m (a short section in the middle has been excavated to 4 m deep), and is completely exposed. The upstream dyke is permeable and water flows through. Extensive instream cover is provided by riprap along the margin adjacent to the highway and dyke. These areas provided shelter for a very dense population of eastern brook trout, both adult and juvenile. The remainder of the backwater is exposed with virtually no available cover for adult fish. Young-of-the-year and older juvenile brook trout were captured among cobble substrate in shallow exposed margin areas. The early emergence of these fry is probably related to the relatively high water

temperature (11°C) in the backwater. This area is likely used for rearing and overwintering. and the presence of young-of-the-year indicates some spawning capability. This type of habitat appears to be relatively unique and may be important in the life history of brook trout in the Bow River.

Unnamed Creek (km 44.8)

No fish were captured downstream of the existing highway. Upstream of the highway the stream is relatively steep (4% gradient) and bouldery with extensive crown and overhang cover. This area provides overwintering and rearing habitat for a small population of cutthroat trout and eastern brook trout.

Copper Lake (km 46.3)

This small lake lies in close proximity to the existing highway on the west side. It is not expected to be directly affected by the proposed highway twinning, but angling pressure may be increased. Parks Canada stocking records indicate this lake was stocked with rainbow trout from 1956 to 1981 and with cutthroat trout from 1981 to the present. Angler success is reportedly fair to spotty. The lake was not sampled during the field studies.

Altrude Creek (km 46.8)

Altrude Creek is a major tributary of the Bow River. There appears to be no complete barriers to fish migration as far upstream as Vista Lake (Underwood McLellan Ltd., 1985). The habitat downstream of the highway is characterized by well developed pool-riffle-glide sequences, numerous side pools to depths of 1 m, and moderate debris, cut bank and boulder cover. Spawning, rearing and overwintering capabilities are considered high. Fish sampling in this area found the habitat to be underutilized considering the habitat quality. Only four eastern brook trout were captured.

Fish sampling was conducted for approximately 1 km upstream of the highway. In this area there are short sections of excellent fish habitat interspersed between long, shallow riffles. A few eastern brook trout were captured as well as one mountain whitefish and one cutthroat trout. The habitat in this part of the stream also appears underutilized. This may be due in part to a short culvert located approximately 0.5 km upstream of the highway which may impede the passage of small fish. The upstream end of the culvert is partially dammed by a submerged log creating a 30 cm drop into the culvert. The downstream lower lip of the culvert is above the deep plunge pool at most flows and may impede passage of some species or sizes of fish.

Taylor Creek (km 55.2)

Taylor Creek has formed or was placed in a new channel from approximately 75 m above the existing highway to its mouth. This channel is primarily composed of shallow riffles over large gravel and cobble. A small population of eastern brook trout exists in this area. An approximate 0.3 to 0.5 m drop occurs at the outlet of the culverts under the highway and may impede upstream movement of fish. Limited fish sampling was conducted upstream since ice covered most of the stream. The upstream, unaltered channel appeared to have more desirable habitat than the lower stream section.

TABLE 3.5-1: SAMPLING SUCCESS IN DRAINAGES CROSSED OR ENCROACHED UPON BY EXISTING HIGHWAY

DRAINAGE	LOCATION[1] (km)*	SPECIES[2] CAPTURED	SHOCKING TIME (s)	CATCH PER UNIT EFFORT[3] (# FISH/100s)	COMMENTS
Unnamed Creek	27.2	-	-	-	Minimal Flow, Very Small
Unnamed Creek	27.5	-	-	-	Minimal Flow, Very Small
Bow River Wetland	27.5	None	267	0.00	
Wolverine Creek	29.6	-	-	-	Dry
Bow River Wetland	30.0	EB	268	5.22	
Unnamed Creek	33.3	-	-	-	Minimal Flow, Very Small
Unnnamed Creek	34.0	-	-	-	Dry
Unnamed Creek	36.0	-	-	-	Dry
Unnamed Creek	36.1	-	-	-	Minimal Flow, Very Small
Redearth Creek	37.4	EB	597	0.67	
Bow River Backwater	40.8	EB	647	6.95	
Unnamed Creek	44.8	EB CT	456	0.66	
Unnamed Creek	45.4	-	-	-	Dry
Altrude Creek	46.8	EB MW CT	2104	0.52	
Unnamed Creek	47.7	-	-	-	Minimal Flow, Very Small
Unnamed Creek	52.5	-	-	-	Dry
Taylor Creek	55.2	EB	413	0.73	
Unnamed Creek	56.4	MW	585	0.17	
Unnamed Creek	58.1	-	-	-	Flowing, No Access to Fish
Unnamed Creek	59.2	None	443	0.00	
Unnamed Creek	61.7	EB	523	2.10	
Unnamed Creek	62.3	-	-	-	Dry
Unnamed Creek	63.0	None	214	0.00	
Moraine Creek	64.3	EB MW	453	5.96	
Unnamed Creek	65.0	-	-	-	Minimal Flow, Very Small
Unnamed Creek	65.6	-	-	-	Dry
Unnamed Creek	66.6	-	-	-	Dry
Unnamed Creek	67.4	None	365	0.00	
Unnamed Creek	69.0	-	-	-	Dry
Bow River	69.3	EB	448	0.89	
Unnamed Creek	74.8	None	377	0.00	
Unnamed Creek	75.0	EB	546	0.18	

1 Sample site number corresponds to kilometerage. Sampling locations are shown on Figure 3.5-1, and biological data are shown in Table 3.5-1.

2 EB - eastern brook trout; CT - cutthroat trout; MW - mountain whitefish.

3 Number of fish captured per 100 seconds of electroshocking.

Unnamed Creek (km 56.4)

This stream is small and exposed, lying in a channel altered during the previous highway construction. A drop culvert located approximately 30 m upstream of the highway prevents further upstream passage of fish. A single mountain whitefish was captured among riprap below this culvert.

Unnamed Creek (km 59.2)

Fish sampling yielded no fish in this small stream. There is some potential for fish rearing at the mouth.

Unnamed Creek (km 61.7)

This is a very small stream which is extremely steep (approximately 20% gradient) from just above the highway. The lower portion of the stream is generally low gradient and exposed with gravelly substrate. Eastern brook trout were numerous from 20 m above the highway to 20 m below. Although it is a small stream it probably flows all winter providing

TABLE 3.5-2: FISH SPECIMENS CAPTURED IN DRAINAGES CROSSED OR ENCROACHED UPON BY EXISTING HIGHWAY

DRAINAGE	DATE	TIME	LOCATION[1] (km)	SPECIES[2]	NUMBER SAMPLED[3]	LENGTH RANGE (mm)	WEIGHT RANGE (g)
Bow River	May 16	1700	30.0	EB	14	27-146	3.8-28.5
Redearth Creek	May 16	1530	37.4	EB	4	101-148	10.5-36.0
Bow River	May 16	1400	40.8	EB	45	21-242	1.2-140.0
Unnamed Creek	May 16	1245	44.8	EB CT	2 1	74-85 140	4.5-5.5 28.0
Altrude Creek (above culvert)	May 16	1120	46.8	EB CT	5 1	133-285 53	21.0-230.0 1.5
Altrude Creek (below highway)	May 16	0915	46.8	EB MW	4 1	76-151 79	3.9-32.0 4.2
Taylor Creek	May 15	1900	55.2	EB	3	160-268	47.0-200.0
Unnamed Creek	May 15	1830	56.4	MW	1	73	3.1
Unnamed Creek	May 15	1630	61.7	EB	11	43-220	0.8-115.0
Moraine Creek	May 15	1330	64.3	EB MW	20 7	52-230 62-74	1.6-115.0 2.3-3.3
Bow River	May 15	1040	69.3	EB	4	59-180	2.0-20.5
Bow River	May 15	0915	75.0	EB	2	150-167	33.0-40.0
Unnamed Creek	May 15	0915	75.0	EB	1	116	20.0

Notes:

1 See Figure 3.5-1 for locations.

2 EB - eastern brook trout; MW - mountain white fish; CT - cutthroat trout.

3 Sampled using a Coffelt BP-4 electroshocker.

some overwintering opportunities. A small area of good spawning habitat occurs just above the highway.

Unnamed Creek (km 63.0)

This is a very small stream which had minimal flow at the time of the survey. The highway culverts probably act as a barrier to upstream fish migration. Fish sampling upstream of the highway yielded no fish.

Moraine Creek (km 64.3)

Moraine Creek is a moderate size stream. Excellent fish habitat extends from 75 m below the highway to its mouth. In this area multiple channels have been created by debris deposition. Extensive debris accumulations occur throughout this area which have created numerous pools and good spawning habitat. A dense population of brook trout inhabit the area. A few mountain whitefish were captured below debris falls at the mouth, but this species may not utilize upstream areas. In the vicinity of the proposed crossing shallow riffles predominate. The stream provides excellent spawning, rearing and overwintering habitat in the lower reach.

Unnamed Creek (km 67.4)

This stream is not accessible to fish. It is crossed by a dirt road approximately 400 m below the highway which has diverted the stream from its original channel and caused it to flow into an area where it ponds and infiltrates. The creek displayed characteristics suitable for fish if access to the Bow River were provided. Rainbow trout have been planted in Temple Lake believed to feed this creek (Ward, 1974).

Bow River (km 69.3)

This section of the Bow River is presently crossed by the highway. It is characterized by a laterally stable channel, with riffles and glides over large substrate. Large substrate along the margins appears to provide excellent rearing habitat, but was found to contain only a small population of brook trout. Natural deposition of fines in this area may affect the capability for juvenile fish rearing.

Unnamed Creek (km 74.8)

This is a small creek fed by groundwater seepage from just above the highway. It flows through a long culvert (approximately 75 m in length) under the railway and empties directly into the Bow River. The culvert is probably a fish barrier and sampling upstream of the railway and upstream of the highway yielded no fish.

Unnamed Creek (km 75.0)

This is a very small stream which enters a silt laden backwater of the Bow River bounded on one side by fill from the railway. It is fed by seepage below the highway. A single brook trout was captured in the short section of stream.

3.5.4 ENCROACHMENT ON THE BOW RIVER

Table 3.2-3 (Section 3) identifies those locations where the existing highway interacts with the Bow River. Particular attention is drawn to km 51.5 and km 55.5 where highway construction has resulted in re-channelization of the river into artificially straightened sections (including the north bank). As a result, habitat quality has decreased, habitat diversity has been removed, and former pools and protected waters have disappeared.

Refer to sheet 2

BOW RIVER WETLAND
km 33.4
Eastern Brook Trout

BOW RIVER WETLAND
km 30.0
No fish captured

LEGEND:

- Area covered by sampling activities conducted for this initial assessment
- * Site designated for aquatic biophysical data

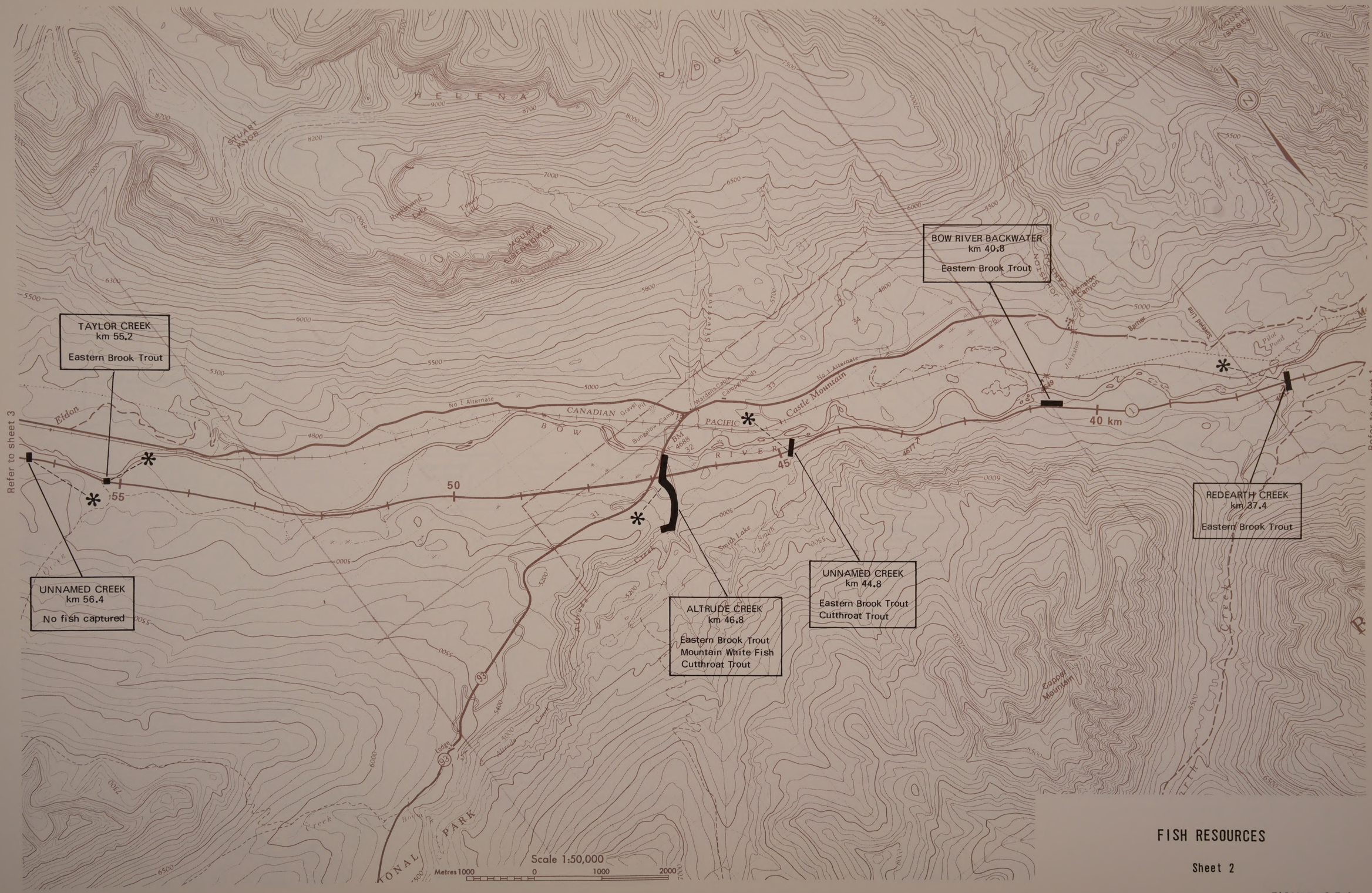
Scale 1:50,000

Metres 1000 0 1000 2000

FISH RESOURCES

Sheet 1

FIGURE 3.5-1



FISH RESOURCES

Sheet 2

FIGURE 3.5-1

UNNAMED CREEK
km 74.8

No fish captured

UNNAMED CREEK
km 75.0

Eastern Brook Trout

BOW RIVER
km 69.3

Eastern Brook Trout

UNNAMED CREEK
km 67.4

No fish captured

MORAINE CREEK
km 64.3

Eastern Brook Trout
Mountain Whitefish

UNNAMED CREEK
km 63.0

No fish captured

UNNAMED CREEK
km 61.7

Eastern Brook Trout

UNNAMED CREEK
km 59.2

No fish captured

Scale 1:50,000

Metres 1000 0 1000 2000

Refer to sheet 2

FISH RESOURCES

Sheet 3

FIGURE 3.5-1

SECTION 3.6

WILDLIFE RESOURCES

This section describes the occurrence, abundance and distribution of mammals, birds, amphibians and reptiles which occur within and may be affected by the proposed Phase III improvements.

Where appropriate, distribution and abundance are discussed in relation to the importance of the biophysical units located along the corridor. These units are based upon the Biophysical Land Classification for Banff National Park (Holroyd and Van Tighem 1983), discussed previously (Section 3.4.1).

3.6.1 MAMMALS

Fifty-four species of mammals can be expected to occur within Banff National Park (Holroyd and Van Tighem 1983). This relatively high species diversity is attributable to the diverse habitats found within the Park ranging from alpine tundra to montane forest and including a number of wetland complexes at lower elevations.

No rare and endangered species of mammals are known to occur along the Phase III corridor.

Small Mammals

Holroyd and Van Tighem (1983) identify seven small mammal associations within the Park, based upon trapping records for insectivores and small rodents that have similar habitat preference. Four of these associations are found within the highway corridor biophysical units (Table 3.6-1). However, none of these associations is restricted to the corridor area. The Panorama Ridge biophysical unit (PR4) is considered to be an important ecosite for small mammals because of the occurrence of the uncommon northern flying squirrel and bushy-tailed wood rat (Holroyd and Van Tighem 1983).

The small mammal associations found along the highway are briefly described below:

Association 1:

The deer mouse is the dominant species. Maximum densities of the deer mouse, least chipmunk and masked shrew occur in this association. It is common in the montane and lower subalpine ecoregions in dry grasslands, juniper/shrub meadows and Douglas fir, and white spruce and Engelmann spruce forests. This association occurs along almost 55 percent of the highway corridor.

Association 2:

The dominant species are the deer mouse and Gapper's red-backed vole. The association occurs mainly in the subalpine closed spruce and pine forests and is the most common association in the study area, occurring along 98 percent of the highway corridor.

Association 3:

This association is dominated by the Gapper's red-backed vole with maximum densities of the vole, yellow pine chipmunk and masked shrew. It occurs mainly in the lower subalpine spruce, pine and fir forests but is also found in black spruce and willow bogs. About 33 percent of the small mammal habitat along the highway corridor falls into this association.

Association 4:

This association is the least common of the four. The dominant species is the meadow vole with maximum densities of the meadow vole, western jumping mouse, northern bog lemming and masked shrew. The association is most common in the lower subalpine, in herb and shrub dominated areas and in black spruce forests. It occurs along 23 percent of the highway corridor.

Ungulates

Five species of ungulates (elk, mule deer, white-tailed deer, moose and bighorn sheep) may be found within the highway corridor. This section provides information on the distribution and abundance of these species, on areas of critical habitat, and on mortality caused by collisions with vehicles.

(a) Elk

The most commonly seen ungulate in the Bow Valley is the elk. Although once occurring naturally in the Park region, the present herds are the descendants of elk introduced from Yellowstone National Park between 1917 and 1920. The introduced herds expanded so rapidly that from 1941 to 1969 a reduction slaughter program was needed to control population levels.

Intensive aerial surveys of elk in the Bow Valley were conducted in 1984 and 1985 (Banff Warden Services files). Elk numbers in the study area from the Bow River Bridge (km 23) to the Castle Mountain Interchange ranged from 256 to 344. In March and May 1985, 30 and 67 elk, respectively, were observed between Castle Mountain Interhcange and Lake Louise. Thus, the total number of elk in the Phase III study area during these months ranged from 317 to 411 animals. These numbers represent about 39-51 percent of the elk population (807) in the entire Bow Valley. While there is substantial variation in the number of elk seen in the study area from year to year and month to month, in general elk numbers increase from low densities at the west end of the project corridor to higher densities at the east end.

Elk tend to be more widely dispersed during summer than winter. Preferred summer habitats are wet alluvial areas with herb, willow or deciduous forest cover, and open avalanche slopes on steep, rocky areas with coniferous forest cover and herb/shrub understories (Holroyd and Van Tighem 1983). During the rut, forested areas are preferred (Holroyd and Van Tighem 1983).

The highest concentration of elk in the study area can be expected in the winter when accumulating snow forces the herds to move from higher elevations down into the Bow Valley. The most important areas of winter habitat between the km 26 and Castle Mountain Junction, are within the Hillsdale and Vermilion Lakes biophysical units (Figure 3.6-1). Twentyfive percent of the highway falls within "potentially important" elk winter range (see Table 3.6-2) and an additional 69 percent is "potentially moderately important" winter range, based on the Banff National Park biophysical land classification maps. However, Figure 3.6-1 shows the known important elk winter ranges in the study area, (based upon winter aerial surveys from 1981 to 1985) located primarily on the north side of the Bow River, with only a small proportion on the south highway side. Much of the habitat on the south (highway) side of the Bow River is considered to be of only moderate importance to wintering elk (Holyroyd and Van Tighem 1983).

Another important aspect of the elk herds is their movement in and through the project corridor. Elk show a pattern of movement between summer range, rutting areas and winter range. Their movements through the valley often involve

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Scientific names of species mentioned in the text (after Holroyd and Van Tighem 1983).

Masked shrew	*Sorex cinereus*
Least Chipmunk	*Eutamias minimus*
Yellow Pine Chipmunk	*Eutamias amoenus*
Northern Flying Squirrel	*Glaucomys sabrinus*
Deer Mouse	*Peromyscus maniculatus*
Bushy-tailed Wood Rat	*Neotoma cinera*
Gapper's Red-backed Vole	*Clethrionomys gapperi*
Northern Bog Lemming	*Synaptomys borealis*
Muskrat	*Ondatra zibethicus*
Meadow Vole	*Microtus pennsylvanicus*
Western Jumping Mouse	*Zapus princeps*
Coyote	*Canis latrans*
Timber Wolf	*Canis lupus*
Black Bear	*Urus americanus*
Grizzly Bear	*Ursus arctos*
American Marten	*Martes americana*
Short-tailed Weasel	*Mustela erminea*
Mink	*Mustela vison*
Cougar	*Felis concolor*
Canada Lynx	*Lynx canadensis*
Mule Deer	*Odocoileus hemionus*
White-tailed Deer	*Odocoileus virginianus*
Moose	*Alces alces*
Elk	*Cervus elaphus*
Bighorn Sheep	*Ovis canadensis*

crossing of the highway. Figure 3.6-1 shows suspected spring and fall movement corridors. They include a small pass connecting the area near the Healy Creek/Brewster Creek confluence with the Bow Valley, the Redearth Creek alluvial fan, and locations near km 31, 34 and 46.5 (S. Logan, pers. comm.).

Seasonal movements contribute to the problem of elk-vehicle collisions along the highway. Vehicle collisions are the major cause of unnatural elk mortality in the study area. This mortality is thought to have a significant impact on the elk populations (Damas and Smith 1982). Elk mortalities from 1977 to 1984 from the Sunshine Road to Castle Mountain Junction totaled 76, with about 27 percent of these occurring in October during fall migration and rut (Logan and Weir 1985). In contrast, elk mortalities from 1975 to 1984 west of the Junction to km 75 totaled only 38. Figure 3.6-2 shows elk mortalities for the Phase III area. Concentrations of road kills occur at km 32-33, 34-38, 43-44 and 46-48.

These road kill concentrations reflect important crossing locations (compare Figures 3.6-1 and 3.6-2) and concentrations of elk on winter range. A 1984 road survey of the project area east of Castle Mountain Junction area showed that the distribution of elk mortality was very similar to elk distribution along the highway corridor and, as may be expected, closely related to the elk winter habitat ratings for biophysical units (Logan and Weir 1985).

(b) Mule Deer

Mule deer are found throughout the Park. They occupy a wide range of open forest habitat types. There is little information on the size of the mule deer population in the Phase III study area. However, a few mule deer have been sighted throughout the area during summer, and east of Castle Mountain Junction during winter (Holyroyd and Van Tighem 1983).

The number of mule deer in Phase III are apparently much lower than in the Phase I and II areas (R Kunelius, pers. comm.). This is reflected in the ratings of the biophysical units. Less than eight percent of the Phase III route passes through "potentially highly important" winter habitat for deer (Table 3.6-2). All of this habitat lies east of Castle Mountain Junction. An additional 75 percent of the route passes through "potentially moderately important" deer winter habitat.

According to Holroyd and Van Tighem (1983), mule deer frequent slopes or terraced areas with open forests or dry meadows. Lodgepole pine, Douglas fir and white spruce forests with dry grass/shrub understories are heavily used. As snow accumulates at higher elevations in the fall, mule deer are forced down into the valleys. The important areas of winter range typically have southern exposures and low snow accumulations and provide both food and cover. The most important habitats for mule deer (rated "very high") are those relied upon in late winter and early spring when mule deer are in their poorest physical condition. Although none of these biophysical units (including HD2, HD4, NY1 and GA1) lie in the proposed Phase III route, they do occur within the Bow Valley, in some cases less than one kilometre from the existing highway.

Highway mortality is a potentially significant problem for mule deer populations along the highway. From 1977 to 1984, 33 mule deer were killed in collisions with vehicles between the km 26 and Castle Mountain Junction; from 1976 to 1984, 27 were killed between the Junction and km 75 (Figure 3.6-2). Five areas where road kills are concentrated are at Sunshine Road, near Redearth Creek at km 37, at Castle Mountain Junction, at km 70 near the Lake Louise interchange, and at km 74 near the Icefields Parkway Interchange. More mortalities occur in November than in any other month of the year (Logan and Weir 1985), when the mule deer move onto winter range along the highway corridor. Road kills are a major cause of mule deer mortality, and some authors have suggested that the populations along the highway will not be able to withstand current levels of highway mortality without suffering a reduction in population size (Holroyd and Van Tighem 1983, Harrison et al. 1982.) However, in view of the lack of information on the total number of mule deer in the valley such suggestions are speculative.

TABLE 3.6-1: SMALL MAMMAL ASSOCIATIONS FOUND ALONG THE HIGHWAY

MAJOR BIOPHYSICAL UNITS ALONG HIGHWAY	PERCENT OF ALIGNMENT	SMALL MAMMAL ASSOCIATION[1]	SMALL MAMMAL DENSITY RATINGS[2]
AL1	11.2	1, 2	low
BK1	5.5	1, 2, 3, 4	high
BK4	16.0	1, 2, 3, 4	medium
BV1	24.3	2	medium
BY2	0.8	1, 3	medium
FR1	4.4	1, 2	high
HC1	1.0	4	medium
HD3	3.3	1, 2	high
IB1	6.9	2	high
PR1	2.9	1, 2	medium
PR2	5.5	1, 2	medium
PR4	5.1	1, 2, 3	very high
PR6	5.4	2, 3	high
VD2	7.7	2	low

1 Refer to text

2 Based upon analysis of trapping data.

TABLE 3.6-2: PERCENTAGE OF EXISTING HIGHWAY TRAVERSING ''POTENTIALLY HIGHLY IMPORTANT ' WINTER RANGE FOR ELK, DEER AND MOOSE, BY BIOPHYSICAL UNIT

AREA	BIOPHYSICAL UNIT	ELK	DEER	MOOSE
Sunshine Rd. (km 26), to Castle Mountain Junction (km 47)	BK1	-	-	2.2
	BK4	13.0	-	13.0
	BY2	-	-	0.8
	FR1	4.4	4.4	4.4
	HD3	-	3.3	3.3
Sub Total		17.4% (8.5)[1]	7.7% (3.8)	23.7% (11.5)
Castle Mountain Jct. to km 75	BK1	-	-	3.3
	BK4	5.2	-	5.2
	PP1	2.9	-	-
	VD2	-	-	7.7
Sub Total		8.1% (2.9)	0 (0)	16.2% (7.2)
TOTAL		25.5% (11.4)	7.7% (3.8)	39.9% (18.7)

Source: Holroyd and Van Tighem, 1983.

1 kms in brackets

(c) White-tailed Deer

White-tailed deer are found in very small numbers in the study area. No actual population estimates are available, and Holroyd and Van Tighem (1983) state that the lack of information makes it impossible to accurately assess habitat use by these deer. Recent surveys suggest that their range is expanding westward along the Bow Valley (R. Kunelius, pers. comm.).

The low population of white-tailed deer is reflected by the small number of road kills in the study area. From 1977 to 1984, eight white-tailed deer were killed between the km 26 and Castle Mountain Junction, with four between km 26 and 38 (Figure 3.6-2). From 1976 to 1984, five white-tailed deer were killed between Castle Junction and km 75, with no observable pattern of kills.

(d) Moose

Moose were at one time abundant in the Bow Valley (Public Works Canada 1981). Over the past few decades populations have been decreasing, and recent estimates put the moose pop-

ulation in the entire Bow Valley at only 15 to 24 animals (Flygare 1978).

During winter, moose prefer forest habitat with shrub undergrowth, and shrublands and sedge meadows during the summer (Harrison et al 1982). An essential component of their habitat is woody browse in early successional stages. This type of habitat typically disappears as plant communities mature toward more stable forested climax stages. Fire suppression may accelerate this disappearance, as no new early-succession stage habitat is created by wildfires. The disappearance of suitable habitat due to lack of forest fires has been implicated as a potential cause of the decline in moose populations in the Park (Public Works Canada 1981).

The proposed Phase III route passes through a number of biophysical units that are rated as "potentially highly important" for moose winter habitat. About 48 percent of the route falls into this category, divided equally between the east and west sections. Three important stretches are located at km 26 - 41, km 47 - 52, and km 60 - 70. During recent surveys 5 to 6 moose were observed on the north side of the Bow Valley between km 30 and km 32 (Mule Shoe Meadows) and between km 42 and km 43 (Moose Meadows) (R. Kinelius, pers. comm.). In addition, 3 to 5 moose are frequently seen in the Lake Louise area during winter (T. Skjonsberg, pers. comm.).

Over the last 10 years, moose fatalities caused by collisions with vehicles have been recorded along the entire highway in the study area. From 1977 to 1984, 11 moose were killed on the highway between Sunshine Road and Castle Mountain Junction, with eight of these occurring between km 27 and km 37 (Figure 3.6-2). From 1976 to 1984, six moose were killed west of the Junction. According to Flygare (1979), there is a "definite correlation between highway mortalities and moose movements to and from winter and summer habitats". This is supported by the concentration of road kills between km 27 and km 37, which is an area of important moose winter habitat. Moose mortalities are more likely to occur during the winter months when moose are forced down from higher elevations to valley bottoms by snow accumulation (Flygare 1979). Because moose populations are so small in the Bow Valley, the level of road mortality is thought to be in excess of predicted surplus productivity (Harrison et al. 1982). The combined effect of habitat loss due to plant succession and road kills probably is responsible for low moose numbers in the Bow Valley.

(e) Bighorn Sheep

Bighorn sheep do not regularly occur in the study area although they are common in the lower Bow Valley, especially in the Phase II area. The proposed Phase III corridor does not pass through any "potentially highly important" sheep habitat. No sheep mortalities due to vehicle collisions have been recorded in this area in the last decade.

(f) Summary - Ungulates

The Bow River Valley contains important ungulate habitat, especially winter ranges. The existing highway passes in close proximity to "potentially important" habitat for elk, mule deer and moose. However, between the Sunshine Road and Castle Mountain Junction the highway is separated from the most important winter range currently being used by elk and mule deer. This winter range is located mostly north of the Bow River. In general, ungulate densities in the project corridor are greatest in the winter when snow accumulation at higher elevations forces the animals down into the lower regions of the Bow Valley. Summer ranges for these species is more dispersed, and includes higher elevations to the north and south.

Populations are at low densities in the Phase III study area. Moose numbers may be limited by habitat availability. Elk sustain the highest road kill mortality of ungulates along the corridor, followed by mule deer and moose. No collision mortality for sheep has been recorded in Phase III.

Carnivores

Carnivores found within the Park include black and grizzly bear, coyotes, wolves, lynx, cougar and the American marten.

Black bears occur throughout the Bow Valley west to Lake Louise and are most often observed in valley bottoms and on south-facing forested slopes. The present population of black bears in the Park is about 120 animals (Holroyd and Van Tighem 1983). Three to five black bears habitually occur around Lake Louise (T. Skjonsberg, pers. comm.).

The main cause of unnatural mortality in black bears is the destruction of "problem" bears. Railroad and highway mortalities constitute the second largest cause of mortality (Holroyd and Van Tighem 1983). Between 1975 and 1980, three highway mortalities were recorded within the study area (Figure 3.6-2). Of these, two were near Lake Louise at km 70. Since 1980 no road kills have been recorded in the study area and only one occurred within the entire Park.

Grizzly bears prefer open unforested areas from the lower montane to the alpine, and tend to be observed less often on valley bottoms than black bears. Typically, grizzly bears are found at lower altitudes in spring and fall and near the alpine in summer. In 1980 there were an estimated 55 to 80 grizzly bears within the Park (Holroyd and Van Tighem 1983).

Grizzly bears have been sighted at the Taylor Creek picnic site (km 55.2) and are known to cross the highway between Redearth Creek and Johnston Canyon and between Sundance Creek and Sunshine Road (R. Kunelius, pers. comm.). During spring, grizzlies are often observed on the north side of the Bow Valley above Castle Mountain Junction and between Massive and Mule Shoe Lake. (R. Kunelius, pers. comm.).

As with black bears, the main cause of unnatural mortality is due to destruction of "problem" bears (Holroyd and Van Tighem 1983). Between 1975 and 1980, four road kills were recorded for the study area, all around Lake Louise (Figure 3.6-2). However, since 1980 none have been recorded in the Park. This decrease in road kills for both grizzly and black bears may have resulted from the installation of bear-proof garbage containers within the Park, starting in 1980.

Coyotes are abundant within the Park. The middle Bow River watershed (Healy Creek to Lake Louise) is less important to coyotes than is the adjacent lower Bow River watershed. This is probably because of greater snow accumulation and absence of garbage sources in the middle Bow area (Holroyd and Van Tighem 1983). Although in the summer coyotes can be more widespread, winter snowfall restricts them to the valley bottom of major river systems (Holroyd and Van Tighem 1983). The concentration of ungulates in valley bottoms during winter also provides coyotes with carrion derived from animals killed along the highway and railway.

Denning habitat is commonly found on well-drained, south-facing sites. Coyote dens are known to occur on the north side of the valley opposite Redearth Creek (R. Kunelius, pers. comm.).

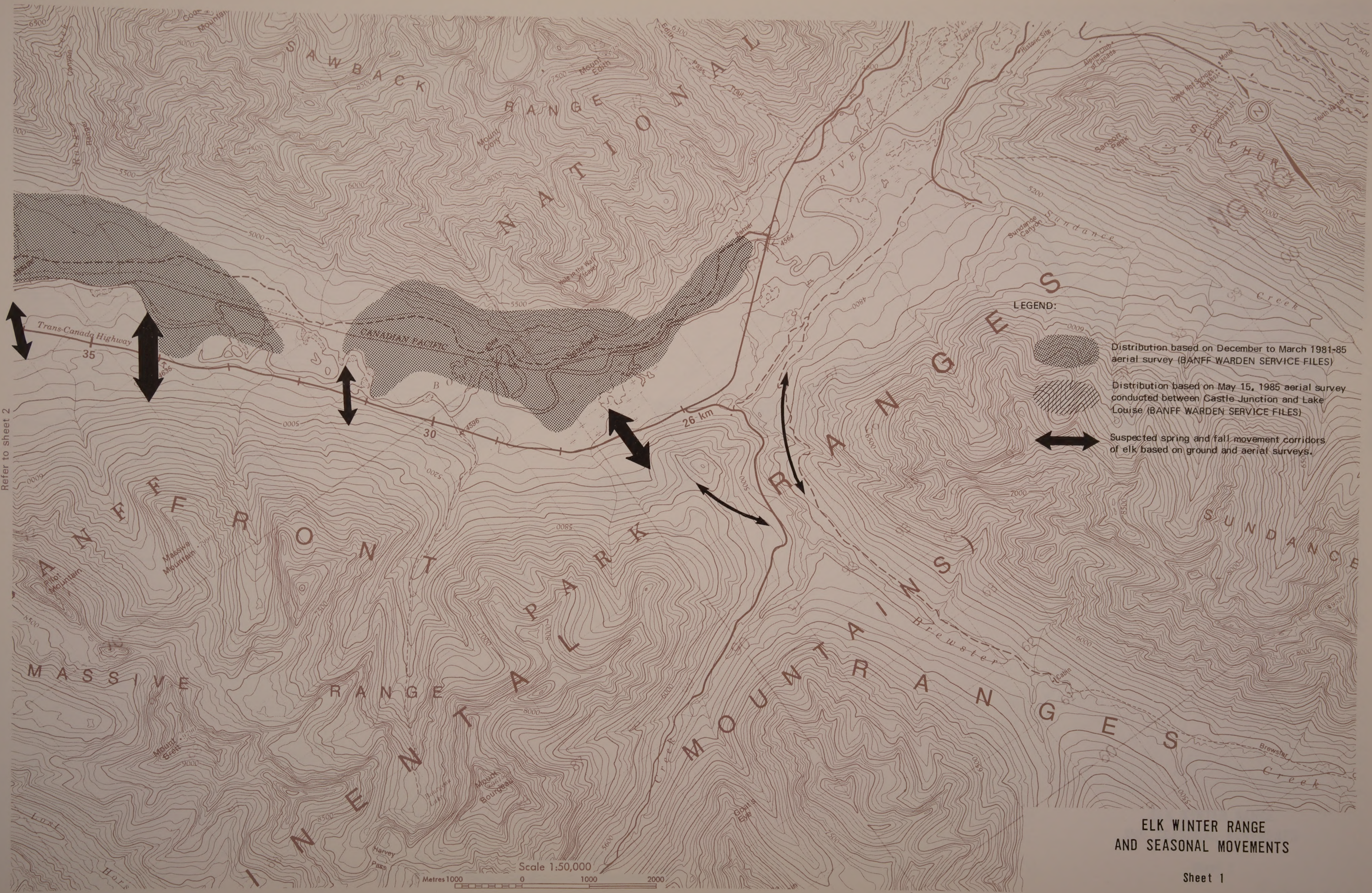
The major unnatural mortality of coyotes results from motor vehicle and train collisions. The incidence of mortality is low relative to the coyote population. From 1975 to 1981 four highway kills occurred within the study area (Figure 3.6-2), all of which were west of Castle Mountain Junction. Three of the four kills were in the Lake Louise area (km 65-72). Since 1981, 13 coyote road-kills have occurred within the Park, however none occurred within the study area.

Timber wolves range widely and the major influence on their seasonal distribution is the distribution of ungulates, their major prey species. Recently, wolf numbers within the Park have been increasing (R. Kunelius, pers. comm.). There are about five packs along major watersheds such as the Spray River. These packs are believed to be non-resident, coming from outside the Park along the East Slope during the summer (R. Kunelius, pers. comm.). On the north side of the valley near Massive, six wolves have been sighted within the last three years. In the late 1940's, two resident packs of 7 to 9 animals were reported near Massive. But, until the recent sightings, it was believed that the 1950's predator control campaign had eliminated resident populations. Since 1975 no highway mortalities have been recorded within the study area.

Canada lynx and cougar are both rare species within the Park. The lynx occurs in the same habitat as its major prey, the varying hare, especially in young dense lodgepole pine forests (Holroyd and Van Tighem 1983). In the winter they often feed on road-killed ungulates. Cougar are most common at low elevations where there is low snow accumulation and ungulates concentrate. Cougars have been sighted along the north side of the Bow Valley near Mule Shoe Lake and Hillsdale Meadow. In May 1975 a female was killed on the highway at Five Mile Bridge (Holroyd and Van Tighem 1983). Two cougar have recently been sighted in the lower Bow Valley (Phase I and II) (Banff Warden Service, pers. comm.).

The American marten is the most abundant carnivore in the Park and is found most commonly in Engelmann spruce-subalpine fir and subalpine larch-subalpine fir forest vegetation types (Holroyd and Van Tighem 1983).

Refer to sheet 2



ELK WINTER RANGE
AND SEASONAL MOVEMENTS

Sheet 1

FIGURE 3.6-1

Refer to sheet 3

Refer to sheet 1

Scale 1:50,000

Metres 1000 0 1000 2000

ELK WINTER RANGE AND SEASONAL MOVEMENTS

Sheet 2

FIGURE 3.6-1

ELK WINTER RANGE
AND SEASONAL MOVEMENTS

Sheet 3

FIGURE 3.6-1

Refer to sheet 2

LEGEND:

- △ 1 Elk
- ○ 1 Mule Deer
- ● 1 White-tailed Deer
- ▲ 1 Moose
- ■ 1 Black Bear
- □ 1 Grizzly Bear

RECORD PERIOD:

1977-84, East of Castle Mountain Jctn.
1975-84, West of Castle Mountain Jctn.

(Refer: Damas and Smith 1981, and Banff Warden Services files.)

LOCATIONS OF WILDLIFE MORTALITY

Sheet 1

FIGURE 3.6-2

Refer to sheet 3

Refer to sheet 1

HELENA RIDGE

STUART KNOB

Eldon

No 1 Alternate

CANADIAN Gravel Pit

Bungalow Camp

Warden's Cabin Campgrounds

PACIFIC

Castle Mountain

No 1 Alternate

Johnston Canyon

Barrier

Pilot Pond

40 km

△O 1 Coyote

55

50

45

Smith Lake

Smith Lake

Copper Mountain

93

93

Scale 1:50,000

Metres 1000 0 1000 2000

LOCATIONS OF WILDLIFE MORTALITY

Sheet 2

FIGURE 3.6-2

1 Coyote
1 Porcupine
1 Coyote
1 Coyote
75
70
65
60 km
Trans-Canada Highway
CANADIAN PACIFIC
RAILWAY
Temple
Lake Louise Townsite
Chateau
Lake Louise
Mount St. Piran
The Beehive
Fairview Mountain 9001
SADDLE MOUNTAIN
Mount Whyte
PENIN OF THE SIX GLACIERS
Mount Aberdeen 10330
SPECIAL MOUNTAIN
Mount Temple 11000
PARADISE VALLEY
Paradise Creek
Paradise Valley Trail
VALLEY OF THE TEN PEAKS
Moraine
MORAINE LAKE ROAD
Valley Trail
Tower of Babel
Babel Creek
CONSOLATION VALLEY
PANORAMA RIDGE
Island Lake
Temple Fire
Ski Lodge
Cabin
Refer to sheet 2
Scale 1:50,000
Metres 1000 0 1000 2000

LOCATIONS OF WILDLIFE MORTALITY

Sheet 3

FIGURE 3.6-2

Three species of weasel occur in the Park but only the short-tailed weasel is common and widely distributed. It is found most often in open sedge, shrub and coniferous forest habitats.

Aquatic Furbearers

Four species of aquatic furbearers American beaver, muskrat, river otter and mink occur in the Park. Their habitat, wide valley bottom wetlands, is limited (Holroyd and Van Tighem 1983).

Beavers are common in the bow Valley east of Lake Louise. Within the study area, they occur most often in marshy backwaters along the Bow River floodplain between km 26 and Castle Mountain Junction.

Muskrats occur only in very restricted areas because of lack of suitable habitat within the Park (Holroyd and Van Tighem 1983). Within the study area, muskrats have been sighted in the same general location as beaver.

River otter are very rare and have never been abundant in the Rocky Mountains. The last reported otter sighting was at Vermilion Lakes (several kilometres east of the study area) in 1977. Most of the past sightings were in marshy waterways also inhabited by beaver and muskrat.

Mink are common in alluvial wetlands in the Park with the majority of the observations in the Bow River valley and the lower reaches of its tributaries. A small resident population occurs along the middle Bow River watershed.

3.6.2 BIRDS

Waterfowl

High quality waterfowl habitat is very limited in the Park and is restricted to the wetlands found within the Vermilion Lakes biophysical units. Within the study area, this habitat extends from km 26 to Castle Mountain Junction (Figure 3.6-3). The highway parallels these wetland units closely but does not presently impinge upon them. These areas are heavily utilized during both the breeding and migration periods. The Bow River, west of the Junction, is less important than the above areas but is still utilized by a few waterfowl species. A number of old borrow pits holding water are used by waterfowl.

Mallards, blue-winged teal, ring-necked ducks and Barrow's goldeneye, reach their highest nesting density in the Vermilion Lakes and associated wetlands (Holroyd and Van Tighem 1983). The Canada goose also breeds regularly in this area. The main channel of the Bow River is not attractive to most waterfowl but it is of particular importance to species such as harlequin and Barrow's goldeneye. Most observations of harlequin have occurred around Castle Mountain Junction and between Moraine Creek and Lake Louise. Barrow's goldeneye tend to concentrate more in the Lake Louise area.

During spring and fall migration periods, the diversity and density of waterfowl species increases and whistling swans are occasionally present during these periods.

Common mergansers are known to breed in the Vermilion Lakes complex and hooded mergansers are present during spring migration.

Raptors

Only a few raptors are present. Osprey are fairly common along the Bow River and at least two active nest sites are known to occur in the study area (Figure 3.6-3). Ospreys arrive in late April and begin nesting in early May (A. Anderson, pers. comm.). About four or five pairs of bald eagles are known to nest in the Park, but none are known to occur within the study area. The closest nest site is located at Vermilion Lakes at km 18.5, outside the study area. The American kestrel is a common summer resident with nesting occurring during June and July.

During spring and fall migration periods increased numbers of osprey and bald eagles are found along the valley.

Passerines and Other Species

According to Holroyd and Van Tighem (1983), eighteen bird communities have been described for the Park. The montane shrub wetland unit (Bird Community 9) found along the Bow Valley, is the most diverse and consequently one of the most important. The distribution of this community is restricted to a limited number of biophysical units, the most important in Phase III being:

i) the Vermilion Lakes units north of the highway extending from km 26 to km 43

ii) areas intersected by the highway at km 27-29, km 47-49 and km 50-52.

The montane shrub wetland community is important to a wide range of species and has the highest breeding density of all bird communities in the Park. Many species reach their maximum densities in this community; this includes the red-necked grebe, American bittern, willow flycatcher, yellow warbler and northern yellowthroat, all of which are species that appear to be undergoing general population declines or range contractions (Holroyd and Van Tighem 1983).

Scientific names of species mentioned in the text (after Holroyd and Van Tighem 1983).

Red-necked Grebe	*Podiceps grisegena*
American Bittern	*Botaurus lentiginosus*
Whistling Swan	*Olor columbianus*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Blue-winged Teale	*Anas discors*
Ring-necked Duck	*Aythya collaris*
Barrow's Goldeneye	*Bucephala islandica*
Harlequin Duck	*Histrionicus histrionicus*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Bald Eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
American Kestrel	*Falco sparverius*
Willow Flycatcher	*Empidonax alnorum*
American Dipper	*Cinclus mexicanus*
Yellow Warbler	*Dendroica petechia*
Northern Yellowthroat	*Geothlypis trichas*

3.6.3 AMPHIBIANS AND REPTILES

Only four species of amphibian and one reptile occur in the Park. All of the amphibian species have been recorded within the study area. The lack of herptile fauna is attributed to climatic conditions and lack of suitable habitat.

The Western toad is common and widespread not being confined to any particular habitat until breeding season when standing water is required (Holroyd and Van Tighem 1983). Several biophysical units west of Castle Mountain Junction, particularly near Lake Louise, are considered to have important breeding habitat.

Although the wood frog is uncommon it may be locally abundant in suitable habitats of shallow meadow or woodland ponds away from running water. Within the study area most observations have been north of the Sunshine Road area in marshy areas and around Lake Louise. Two important breeding sites that have had exceptional concentrations of wood frogs are Mule Shoe Lake and also approximately 1.5 km east of the lake near Highway 1A (Holroyd and Van Tighem 1983).

The spotted frog is rarely seen in the Bow Valley (Leeson 1979). This aquatic species is found in the vicinity of permanent water bodies and has been sighted around Lake Louise and Altrude Creek.

The long-toed salamander is uncommon and has only been recorded in ponds east of Castle Mountain Junction. It occurs mainly in wetlands and on alluvial fans, aprons or terraces. Trout predation on salamander larvae precludes their coexistence. The salamander population in Pilot Pond, known locally as Lizard Lake due to the high numbers of salamanders, was eliminated as a result of trout stocking (Holroyd and Van Tighem 1983).

Scientific names of species mentioned in the text (after Holroyd and Van Tighem 1983).

Western Toad	*Bufo boreas*
Wood Frog	*Rana sylvatica*
Spotted Frog	*Rana petiosa*
Long-toed Salamander	*Ambystoma macrodactyum*

WETLAND HABITAT

Sheet 1

FIGURE 3.6-3

Refer to sheet 3

Refer to sheet 1

WETLAND HABITAT

Sheet 2

FIGURE 3.6-3

WETLAND HABITAT

Sheet 3

FIGURE 3.6-3

SECTION 3.7

LAND USE AND RECREATION

As the study area lies within a National Park, unorganized recreational activities occur to varying degrees throughout the corridor. There are a number of park facilities which are currently accessed from the TCH that serve these activities. This section contains an overview of Park planning and use in the vicinity of the proposed project and a description of specific sites and facilities along the route from km 27 to km 75.

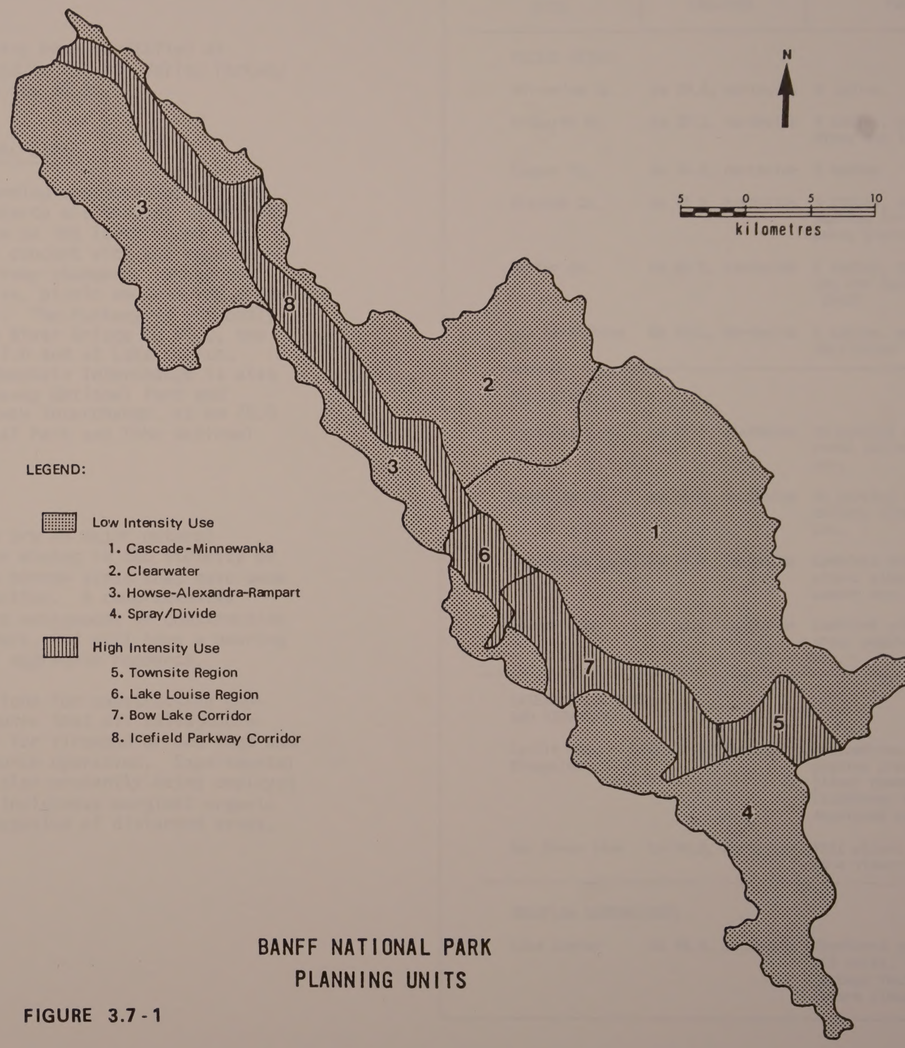
3.7.1 PARK PLANNING AND INTERPRETATION

Further review of recreational land use issues and facilities in the Bow Valley Corridor is being undertaken as part of the Banff National Park Management Planning Program. This approach sees the Park divided into low and high intensity use units. Eight planning units have been identified; 4 of each type as shown in Figure 3.7-1. Individual master plans are being developed for each unit and upon completion of these a total Park master plan can then be compiled.

Each of the unit master plans embodies, where applicable, plans and recommendations pertaining to resource management, vehicular and non-vehicular circulation, public and private accommodation, natural and cultural resource interpretation, visitor use facilities and overall unit land use. These unit plans serve to guide the maintenance, development, redevelopment or rehabilitation of the unit's resources, facilities and use opportunities. The first unit considered under this planning approach has been the Bow Valley Corridor.

The project corridor (km 27-75) is within the Bow Lake Corridor and Lake Louise planning regions. These high intensity use units, as described in the Parks 1976 planning report, will be oriented toward optimizing man's opportunities for use, benefit and enjoyment, while simultaneously seeking to maintain the integrity of the natural environment. This orientation differs from that of a low intensity use unit in that resource protection is less stringent allowing for greater facility development.

Parks Canada recognizes the need to reduce conflicts between those destination-oriented travellers wishing a rapid travel route through the Park and those seeking a more pleasurable, scenic driving experience. The Bow Valley Management Plan (1978) recognized the need to separate these two user groups and acknowledged the proposed modifications to the TCH to provide rapid through travel and the development of Highway 1A to parkway standards. The latter is being accomplished with the final section of the Bow Valley Parkway now in the design stage. In order to optimize rapid travel on the TCH the Bow Valley Management Plan proposed:



BANFF NATIONAL PARK
PLANNING UNITS

FIGURE 3.7-1

- the removal and rehabilitation of all picnic sites along the TCH;

- that trailhead parking facilities be upgraded at Bourgeau Lake, Redearth Creek, Twin Lakes/Smith Lake and Taylor Lake trails. Alternatively, these facilities could be relocated to the Bow Valley Parkway. The latter option would involve construction of pedestrian crossings for the Bow River and TCH

This was further reinforced at a meeting of Western Region managers on the subject of the Bow Valley road system (July 26, 1983) which concluded the following:

- it was only a matter of time before the TCH twinning program would carry on to Lake Louise;

- that a rural freeway was being created to move high volume of traffic at high speeds and that an alternate low-key road was needed for Park visitors seeking a more leisurely sightseeing driving experience (The Bow Valley Parkway); and

- that no attempt should be made to have Park features such as trailheads or interpretive displays along the high speed freeway, rather these facilities should be accessed from the low-key road.

Although this approach was also adopted for the planning of Phases I and II of the TCH, several examples of departures from this approach have already occurred. These include Valleyview picnic site, the km 19 viewpoint, and the recent retention of the Riverside picnic site. While there may be few picnic sites which remain, these other facilities are deemed valuable because of their access to/from the Bow River, which is an important recreational resource in Phase III.

3.7.2 SPECIFIC RECREATIONAL SITES AND FACILITIES

The existing picnic sites, trailhead facilities, viewpoints, interpretive sites and overflow campgrounds adjacent to the highway are described on Table 3.7-1.

Current planning options favour future closure of the Lake Louise overflow campground at km 66.6 in concert with the proposed expansion of the Protection Mountain and Johnston Canyon Campgrounds on the Bow Valley Parkway.

Recreation planning of the Bow Valley Corridor places a greater emphasis on encouragement of canoeing/kayaking/rafting of the Bow River. Three major access points exist in the study area:

- Redearth Creek (km 37.3); in conjunction with the picnic facilities.

- Castle Mountain Junction (km 47.0); by utilizing the Bow Valley Parkway access leg of this interchange, boaters may access the Bow River from the launching area provided on the north bank of the river.

- Bow River Bridge, Lake Louise (km 69.3); parking is presently located on the southeast side of the bridge. This requires launching at the head of the Louise Rapids or a portage. Alternate access points exist below the rapids.

Other potential sites have been identified at Protection Mountain Campground on the Bow Valley Parkway and Moraine Creek on the TCH (km 64.2).

3.7.3 OTHER NEARBY RECREATIONAL SITES

As mentioned earlier the planning approach for the Bow Valley Corridor has been to eliminate all tourist facilities from the TCH and concentrate them on the lower speed Bow Valley Parkway. To this end, in concert with the reconstruction of this roadway to parkway standard, varied and numerous trailhead, interpretative, picnic and camping sites have been provided on this route. The Parkway is presently accessed from the TCH at the Bow River Bridge km 24.0, the Castle Mountain Interchange km 47.0 and at Lake Louise, km 70.0. Access at the Castle Mountain Interchange is also provided via highway 93, to Kootenay National Park and Radium, B.C. The Icefields Parkway Interchange, at km 75.0 provides access to Jasper National Park and Yoho National Park.

3.7.4 OTHER RESOURCE USERS

Due to the Park status there are no major natural resource uses such as forestry or mining in the vicinity of the highway. There are numerous borrow areas that have been used in previous highway construction. A comprehensive report covering the inventory and management of construction materials is available for the Park, and will have a bearing on the future use of the mineral aggregate resource.

Existing clearing specifications for construction contracts in the Park presently require that all salvageable trees must be stockpiled, either for firewood or saw logs and as such may be considered a resource operation. Experimental contracts for wood chipping are also presently being employed as a means of supplementing the indigenous marginal organic soils that are necessary for revegation of disturbed areas.

TABLE 3.7-1: EXISTING PICNIC SITES AND TRAILHEADS ADJACENT TO EXISTING HIGHWAY

SITE	LOCATION	FACILITIES
PICNIC SITES:		
Wolverine Ck.	km 29.6, northside	6 tables
Redearth Ck.	km 37.3, northside	4 tables, access to Bow River and launching area.
Copper Ck.	km 44.9, northside	5 tables
Altrude Ck.	km 46.8, southside	5 tables, trailhead parking for Twin/Smith Lakes trails.
Taylor Ck.	km 55.2, southside	7 tables, trailhead parking for Taylor Lake trail
Bow River View	km 64.3, northside	5 tables, no toilet facilities
TRAILHEADS:		
Bourgeau Lake	km 29.5, southside	20 parking stalls, year-round toilet; high summer use.
Redearth Ck.	km 36.0, southside	36 parking stalls, toilet; high year-round use.
Twin/Smith Lakes	km 46.8, southside	Combined with Altrude Ck. picnic site; popular summer use.
Taylor Lake	km 55.2, southside	Combined with picnic site; popular year-round use.
INTERPRETIVE SITES AND VIEWPOINTS:		
Castle Mtn. Viewpoint	km 38.1, northside	Precambrian rock interpretive plaque, also plaque commemorating Eisenhower Peak; well developed and used.
Bow River View	km 64.3, northside	This picnic site serves as a viewpoint.
OVERFLOW CAMPGROUNDS:		
Lake Louise	km 66.6, southside	Abandoned gravel pit, 225 units, toilet and garbage facilities; future closure intended.

Refer to sheet 2

LEGEND:

- Picnic sites
- Overflow campgrounds
- Trailheads
- Interpretive sites/viewpoints
- Bow River access/egress points

PARK FACILITIES

Sheet 1

FIGURE 3.7-2

PARK FACILITIES

Sheet 2

FIGURE 3.7-2

PARK FACILITIES

Sheet 3

FIGURE 3.7-2

SECTION 3.8

LAND USE HISTORY AND ARCHAEOLOGY

3.8.1 LAND USE HISTORY

Prehistoric Period

The Bow River Valley corridor west of Castle Mountain Junction was deglaciated at least 12,000 years ago while that area to the east appears to have been ice-free for at least 14,000 years (Fedje and White, 1985). Recent archaeological excavations conducted by Parks Canada in the Vermilion Lakes area (Fedje and White, 1984) indicates that the upper Bow Valley was used by prehistoric peoples since 11,000 years ago. It is feasible this record which continues through to Eurocanadian contact may eventually be pushed back another 500 to 1,000 years to the time of the earliest, generally accepted, occupation of the continent. Archaeological evidence (Fedje and White, 1984, 1985; Robinson, 1985) indicates these peoples utilized a wide variety of resources including bison, moose, wapiti, cariboo, deer, bighorn sheep, beaver, porcupine, hare, ground squirrel and fish. In addition vegetal resources were almost certainly used although as yet the evidence for such is lacking.

The prehistoric inhabitants of the study area were hunters and gatherers, procurring plant and animal resources which they encountered during their seasonal movements. Their exploration of these and other resources (e.g. stone for tools) in turn influenced the local settlement pattern. Living in small social bands they presumably occupied given sites for short periods of time (up to a year).

Occupying temporary shelters constructed of perishable materials, i.e. poles, branches, sod and hides, little is preserved. All that remains of their prehistoric campsites exists in the form of scattered bone fragments from butchered game, hearth remains from cooking activity, and lithic materials in the form of broken and/or discarded tools and chipped waste flakes from tool manufacturing.

The primary ecological effects of the ancient peoples cannot be determined with certainty. However they may have contributed to the extinction of large mammals such as species of bison and the mammoth which lingered briefly in post glacial North America and may have occasionally depleted numbers of certain game animals such as bison and wapiti. Locally their fires may have affected vegetation succession patterns.

The Kootenay Indians who were centred on the western slopes of the Rockies, were the earliest known native inhabitants of the valleys surrounding the project area. The Kootenays were pressured by plains Indians from the East including the Cree, Blackfoot, Sarcee, and Stoneys who had obtained guns and progressed with the fur trade from the early 1700's. At times the Kootenays were forced to abandon strategic trails to the plains and by 1730 they were driven out of the East Gate area. By the early 1800's the historic native occupants of the area were the Assiniboine (Stoneys).

The arrival of the horse from early Spanish stock in the American southwest and increased use of traded European implements, meant that traditional Indian land use methods were in a state of flux by the time substantial contact was made with white men in the early 1800's. Alcohol and disease accompanied the white invasion of the mountain region and rapidly ended the Indian dominance of the mountain region by the late 1800's.

Until the early historical period and the arrival of the gun and the horse, Indians are presumed to have had minor effects on the ecology of the area. The reasons were entirely pragmatic since the population of tribes was linked to the land's carrying capacity. Effects of overhunting became apparent in the 1800's when Indians became supplied with guns, horses and other implements and when there were special pressures on the land from the setting of extensive forest fires.

Historic Period

The initial white European penetration into the study region was to further the interest of the eastern based fur-trading organizations and to develop lines of trading posts to the west. The various trading posts, forts and houses brought a number of white traders, trappers, explorers and missionaries into the area.

The first European reference to the Rocky Mountains was by Anthony Henday, who ventured southward of the present city of Red Deer during the winter of 1754-55. Succeeding Henday, was David Thompson, who, during the winter of 1787-88 entered the Bow River Valley. Although he did not penetrate the mountains, Peter Fidler in 1792 noted viewing the eastern approach to Lake Minniwanka while wintering "along the base of the Eastern Ranges from Chief Mountain to the Devil's Head near the Ghost River".

Other Euro-Canadians who passed through the park area include Le Blanc and Le Gasse (1800), Thompson (1800, 1807), Joseph Howse (1810), Alexander Henry the Younger (1811), James Sinclair (1841, 1850, 1854), George Simpson (1841), Father Pierre Jean de Smet (1845), Vavasour and Ware (1845), Reverend Rundle (1848), James Hector (1858), Captain John Palliser (1858), and the Earl of Southeask (1858).

The first white man to venture west along the Bow Valley into the vicinity of the project area was Sir George Simpson. Simpson, who in 1841, while on his journey around the world, ascended the Bow River, where he crossed at the mouth of Healy Creek, traversing Simpson Pass to Kootenay Valley. Little recorded white activity took place in the study area until 1858, when Dr. James Hector of the Palliser Expedition passed west through the Bow River valley, continuing up the Bow, he turned west and crossed the Vermilion Pass, via "little Vermilion Creek" (Altrude Creek) to the upper Kootenay River.

The following year, 1858, the Earl of Southesk, a Scottish aristocrat, descended the Pipestone River, reaching the Bow Valley below Lake Louise. Following the Bow River, he camped near Castle Mountain, where the following day he proceeded eastward to Cascade Mountain.

In the years 1881 and 1882 the area was surveyed for the coming railroad and the camps and settlements began to appear in the area. The activity related to the early Canadian Pacific Railway had profound land use effects beginning in the 1880's. A tote road along the north side of Vermilion Lakes was used for the construction of the railway in 1882. In 1881 copper was discovered, influencing the growth of Silver City (Silverton) in the vicinity of Castle Mountain, however, by 1886 the town was completely abandoned due to the lack of placer deposits. In 1885 a 10-square mile hot spring reserve was placed by the Federal Government of Canada around the present site of Banff and in 1886 the Anthracite Coal Company began production. These activities, which were undertaken in direct support of the new railroad, were accompanied by railroad promotion to increase passenger traffic. Banff townsite was rapidly settled in 1886. Economic development related to the railroad continued through 1900's and in 1904 the railway opened the Bankhead mine 4 miles northeast of Banff on the road to Lake Minnewanka. By 1911, Bankhead town had a larger permanent population than Banff. In 1911 and 1912 a Calgary power hydro-electric development involved the diversion of the Cascade River into Lake Minnewanka. Thus land uses involving tourism, transportation, resource extraction and related settlements in and around Banff Park began in the mid 1880's and have persisted until the present.

Lumbering began in the park during the 1880's. Timber limit surveys were initiated in the projected area during 1883-1884, where 103 sq. miles (Areas C and D) were surveyed for the Eau Claire and Bow River Lumber Company, Wisconsin. It was not until 1964 that new timber cutting areas would no longer be granted to the various lumber companies.

A long regional history of hunting for sustenance was ended in the 1930's when the Federal Park and Provincial Forest Reserve boundaries were officially established and hunting was made illegal. After 1940 fishing licences were required of tourists and Park residents.

By 1911 a road called the Pacific Auto Drive (Banff Coach Road) had been built from Calgary to Banff. This roadway extended to Golden by 1926 and by 1956 the Trans Canada Highway through the Park was completed to its present standard. Land use related to tourism and transportation is now a dominant theme of the Bow Valley corridor. Access to the area was improved by the railway in 1886, by the road in 1926 and by aircraft in 1936 after a small airstrip was built at the base of Cascade Mountain*. Mineral resource use of the area has

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*The airstrip was built as a make-work project. Between 1946 and the early 1950's the strip was used for emergency landing only, and was occupied by the Cascade Golf and Country Club.

declined since the closing of the Anthracite mines in 1904. Grasslands were used for horse and cattle grazing until the 1930's and some timber was cut locally for mine props until the 1920's. At present, the wild life, vegetation and other natural attributes of the project area have assumed special visual and scientific value.

By the time the early railroad surveyors reached the Banff area, game was heavily depleted. The wood bison which had been a staple for the Indian population was rare and other species such as wapiti were uncommon. Prospectors' fires were often cited as the reason for major game depletions. Associated with these fires were vegetational changes leading to the development of large stands of aspen and lodgepole pine. There was also a temporary increase in the extent of mountain grasslands. The land use changes in the last 100 years have profoundly altered the valley

3.8.2 ARCHAEOLOGY

The 1984 survey reconnaissance from Sunshine Road (km 26) to Castle Mountain Junction (km 47) resulted in the location of 12 heritage resource sites. Of these, five were of historic origin, four were prehistoric, two were palaeontological and one site exhibited both prehistoric and historic components. The site locations are indicated on Figure 3.8-1.

Site EgPw-2

An historic refuse site located approximately 20 m south of the TCH at km 27.4, on disturbed terrain, resulting from construction of an old tote road 12 m further up-slope. It consists of a pile of evaporated milk cans within a 4 m area and is assumed to have been used by 1950's construction crews. The site is of low archaeological significance.

Site EhPw-13

A prehistoric quarry site on a bench associated with hummocky landslide deposits at km 31.3. It is on the north side of an abandoned stream channel 10 m above the Bow River, extending some 175 m north of the TCH. It contains some lithic debris, stone tools and core nodules, and is a source of chert materials. As these site types are scarce in the Bow Valley and contribute qualitative information on prehistoric technology systems, it is seen as having high heritage value.

Site EhPw-14

A palaeontological site located in the vicinity of Castle Mountain Viewpoint (km 38.1) and contains fish and some invetebrate fossils from the Triassic (see Section 3.8.3).

Site EhPw-16

An historic bridge structure located approximately 210 m upstream on the Wolverine Creek alluvial fan at km 29.4. It consists of two rectangular-shaped log bridge footings on the creek's left bank. The bridge serviced an old tote road and is of low archeological significance.

Site EhPw-17

An isolated palaeontological find immediately across the Wolverine Creek from Site EhPw-16. Consists of a single deer metacarpal element (Odocoileus sp.) exhibiting gnawing on the distal condyle surface. The remains were discovered in the creek bank 5.6 cm below the surface. Due to the site's disturbed context and unproductive inspection results it is tentatively rated as of low heritage value.

Downstream from this site, approximately 10 m south of the TCH km 29.5 on the right bank, there is evidence of deeply buried palaeosols bearing burnt organic (charcoal) deposits. Although inspections of the profiles and nearby shovel-tests were unsuccessful in revealing the presence of cultural/fauna materials, their presence is indicated.

Site EhPw-18

A prehistoric campsite on a very narrow fluvial terrace 12 m above the Bow River approximately 35 m north of the TCH at km 32.4. Items found included black chert flakes collected from the upper 25 cm of an excavation and other lithic flakes scattered on the surface. The site is approximately 25 m long by 5 m wide. It is of moderate heritage value.

Site EhPw-19

An isolated historic surface find at approximately km 35.7. It is an empty one U.S. quart sized aircraft-grade lubricant container dating from the 1940's. It is of low archaeological value.

Site EhPw-21

A prehistoric campsite/lookout 35 m north of the TCH at km 33.2, bisected by an old tote road and probably disturbed by original TCH construction. A moderate to moderately heavy scatter of black chert flakes extended over an area 75 m long by 8 m wide, and 2 stone tools were found. The site is of high archaeological significance.

Site EhPw-22

This site has both prehistoric and historic components. It is located 20 m north of the TCH at km 37.5. The historic structure is a subterranean food storage/drying rack comprising of four unnotched logs on three sides, extending into the crest of the embankment and containing a rack of branches. Prehistoric finds from shovel-testing consisted of three lithic flakes. The site holds high potential for further recovery of prehistoric resource data.

Site EhPx-27

An isolated historic surface find located at km 45.3, 20 m south of the Bow River, across the river from the historic townsite of Silver City, which was occupied during the early 1900's. The artifact is a single cylindrical metal container and may be a piece of refuse associated with the townsite. The site is of low archaeological significance.

Site EhPx-31

There is evidence of prehistoric activity at this location (km 45.5) 75 m south of the Bow River and approximately 45 m north of the TCH. Lithic flakes were found during shovel-testing. The site's area is less than 100 sq. m. The site is of low to moderate archaeological value.

Site EhPx-32

An isolated historic surface find 25 m south of the TCH at km 45.8. It consists of ceramic soup-bowl fragments bearing a C.P.R. monogram, dating from post-1946. The site is of low value.

3.8.3 PALAEONTOLOGY

An important palaeontological site exists at km 43.2 in the vicinity of the Castle Mountain Viewpoint. It exhibits excellent diversity and preservation of fish fossils in shales belonging to the Lower Triassic Sulphur Mountain Formation (Spray River Group).

The fish fossils, and some invertebrate fossils such as ammonites, come from boulders of black shale along the river bank, from boulders and slabs weathering out and sliding down the river bank, and from a single large boulder that is on display in the parking lot. A few fragments of the same kind of shale were located in the soil on the opposite side of the highway. It is likely that the area beneath the present highway and the proposed highway is composed of soils and talus that would include a few boulders and scattered fragments of the shale.

The site is across the river from a Quaternary landslide that is composed almost entirely of shales of the formation that contains the fossil fishes. The locality may represent an unmapped extension of the landslide.

Although fish fragments are common in the formation, localities with well-preserved, articulated fish skeletons are more unusual. The nearest comparable locality is at Massive on the railway about a kilometre or two from the highway locality. Fossils from Massive were first collected and reported in the scientific literature between 1910 and 1930. The highway locality ranks second to Massive as the site with the greatest diversity and best preservation of Triassic fishes known from Banff/Jasper National Parks.

3.8.4 ARCHAEOLOGICAL POTENTIAL WEST OF CASTLE MOUNTAIN JUNCTION

Only that section of the highway between km 26 and km 47 has been assessed to date.

Beyond km 47, because of the northern aspect and rocky terrain, it is expected the relatively low heritage site density indicated by the previous section will continue. However, this expectation does not necessarily correlate with

LEGEND:

Eg Pw-2	Historic refuse
Eh Pw-13	Prehistoric quarry
Eh Pw-14	Palaeontological
Eh Pw-16	Historic tote road bridge
Eh Pw-17	Skeletal remain (deer)
Eh Pw-18	Prehistoric campsite
Eh Pw-19	Historic artifact
Eh Pw-21	Prehistoric campsite
Eh Pw-22	Prehistoric and historic
Eh Px-27	Historic artifact
Eh Px-31	Prehistoric
Eh Px-32	Historic artifact

ARCHAEOLOGY

Sheet 1

FIGURE 3.8-1

ARCHAEOLOGY

Sheet 2

FIGURE 3.8-1

low archaeological significance. On the contrary, this area was likely used for resource exploitation as a part of the seasonal procurement patterns of aboriginal peoples. As such any archaeological sites could be significant to a comprehensive interpretation of prehistoric lifeways in this area.

Assessment of the Bow Valley Parkway in 1982 (Steer & Fedje) indicated that the density of prehistoric site locations was highest along the existing and abandoned banks of the Bow River.

SECTION 3.9

VISUAL RESOURCE

3.9.1 INTRODUCTION

This overview of the visual characteristics of the existing highway comprises two parts:

- A description of the existing visual qualities of the Bow Valley as experienced by a traveller on the TCH (i.e. the views from the highway).
- A description of the impacts of the existing highway on the scenic qualities of this area of the Bow Valley (i.e. the views of the highway).

3.9.2 VIEWS FROM THE EXISTING HIGHWAY

The visual experience can be described in terms of the overall visual structure of the Bow River Valley, i.e. the extent, types and quality of views and the landscape compositions. As such, the study area falls into two sections, each with a distinctive character. The boundary between the two sections is located in the vicinity of the Castle Mountain Interchange. Some aspects of the visual experience are common to both east and westbound travel, while others are important only while travelling in one direction.

This information is summarized on the visual analysis map, Figure 3.9-1, and on Table 3.9-1.

Notwithstanding the proximity of the highway to some of the most visually exciting landscapes in Canada, the drive west of Castle Mountain Interchange tends to be monotonous. This results from a combination of unchanging lodgepole pine vegetation and an alignment comprising a series of long straight tangents totalling some 20 km. East of the interchange, the highway alignment has greater horizontal and vertical diversity, and the vegetation shows more variety. Consequently the drive is more enjoyable.

Opportunities to view the Bow River occur at several distinct points in both sections, but more so in the east section. These river views add necessary visual interest to the drive. The occasional view of recreationists on the river (canoeists), reinforces appreciation of the national park image and purpose. Even so, at a number of points where views of the river occur, construction of the existing highway has required relocation or alteration of the river channel. In some cases this has involved regrading the opposite bank of the river and the result is a straight and unnatural appearing river edge.

The opportunity to view wildlife is, of course, an important part of a trip through the Park. Presently, these opportunities are best in areas with views of water. Other open areas, primarily borrow areas, also provide opportunities for wildlife viewing because of the grassland habitat created and also because of the increased visibility.

In both sections of the highway there are a number of cut slopes that contrast with the virtually continuous forest cover of the surrounding landscape. Most of these cuts have revegetated quite successfully with grasses, but several cuts remain a visual problem,

3.9.3 VIEWS OF THE EXISTING HIGHWAY

The highway corridor can be viewed from several important Park use areas, these include: the Bow Valley Parkway, the Bow River, the railway, the Lake Louise ski area, Sulphur Mountain, and various trails (refer Figure 3.9-1).

Bow Valley Parkway

The Parkway has been redeveloped to provide an opportunity for leisurely recreational driving and cycling. It accommodates recreational travellers who can be presumed to be sensitive to scenic qualities. They travel at slow speeds, obtaining sustained views of the valley in some areas. Views of the valley from much of this route are screened by forest cover but there are sections where there are panoramic views, particularly a 6 km long section northwest of the Back Swamp Viewpoint and a 3 km section southeast of Protection Mountain Campground. There are also two additional viewpoints with panoramic views: the Storm Mountain Viewpoint and the Back Swamp interpretive site. The visual impact of the highway as viewed from these locations is not severe.

Bow River

The river is popular for canoeing, kayaking and rafting. The highway has a significant noise and visual impact on this experience. The river and highway interface at about eleven points between km 26 and 70, and at most of these points the river literally flows adjacent to the highway for distances of up to 1 km. The visual impacts at these locations comprise the highway structure, vehicles and unnatural alterations to the river channel.

The highway also has a postive impact on river recreation by providing access to the river, with several different access points being used, depending on the type of river trip desired.

The Railway

The number of viewers involved here is small. However, the traditional importance of the rail trip through the Rockies and the views from the dome car both to Canadians and to international tourists should not be overlooked. Presently, the highway between km 26 and 70 has no significant impacts on this experience.

TABLE 3.9-1: OVERVIEW OF VISUAL EXPERIENCE OF TCH TRAVELLER

	COMMON TO BOTH DIRECTIONS	WESTBOUND	EASTBOUND
SUNSHINE RD. - CASTLE MOUNTAIN JCT.	Due to location of the highway at the base of the slopes on the south side of the valley, views to the south are generally restricted by topography and, to a lesser extent, screened by trees. The highway has a fairly continuous horizontal and vertical curvilinear alignment which contributes to an enjoyable drive when traffic is light. The road edge (the foreground in the landscape composition) provides visual variety, with several views of the Bow River and natural clearings. Also, much of the forest cover has a significant component of spruce and aspen poplar, providing an attractive visual edge by virtue of the variety of forms and colours which change seasonally.	The principal feature is the visual focus and domination of Castle Mountain. This landscape scene, one of the most-photographed in the Canadian Rockies, leaves viewers with highly positive vivid image of this region. However, its dominance over this entire section has a slight detrimental effect. It is more or less continuously in view, and because of this unchanging composition, there a lack of sequency through this section. A westbound traveller tends to view the Sawback Range from an oblique angle, and the distinctive patterns, texture and colours created by the white limestone slabs tend to be lost. While the Bow River can be viewed in both directions at a number of points, some aspects of it are better appreciated from the westbound lanes. At some points there are crystal-clear and still backwaters of the river. These ponds make a definite contribution to the visual variety of the drive. In addition to a number of cut slopes, there is a major rock cut at km 44 which, by virtue of its unnatural appearance, is a visual intrusion.	The Sawback Range becomes the chief area of visual interest. The Hole-in-the Wall is important visually, being a major local natural curiosity. Also, the contrast between the geology of the Main and Front ranges of the Rockies is very apparent to the eastbound traveller upon viewing the Sawback Range. Although the Sawback Range constitutes a visually-interesting enclosure the eastbound drive lacks the distinctive visual focal point of the westbound drive. At the east end of this section visual attention tends to focus on the access road that climbs the west side of Sulphur Mountain. This is a major visual intrusion into an otherwise natural setting.
CASTLE MOUNTAIN JCT. - LAKE LOUISE	The highway continues on the south side of the valley. Consequently, views of the major peaks of the Bow Range (e.g., Mount Temple) are limited by topography and forest cover. The geometery of the highway is one of long tangents and short curves, and because it traverses flat terrain, there is very limited vertical diversity. This lack of variety contributes to a lack of visual interest (see Figure 2.2-2, Sh. 3 & 4 The forest cover is mainly even-aged stands of lodgpole pine. The chief visual characteristic of this type of forest is its extreme uniformity. A natural corridor is created by a wall of poles---overall a monotonous visual experience. The enclosed corridor effect is exacerbated on this section by few natural openings. Most of the few clearings that do occur have unnatural edges resulting from the rectangular borrow area of previous highway construction. There are several points where the highway and river interface. In addition to adding the visual interest of water, these settings create opportunities to view well-composed landscapes including foreground, middleground and background elements. The views are an important and welcome respite from an otherwise largely uninspiring experience.	The westbound drive offers better northwest views of the peaks and icefields of the Waputik Range and Mt. Hector. Although these provide a visual focus, they are at such a distance as to have limited effect. The cuts for access roads in the Lake Louise ski area on Whitehorn Mountain have not been properly rehabilitated and are an unnatural visual intrusion into this section.	The eastbound drive has a visual focus on Pilot and Copper Mountain.

LEGEND:

- Limits of well-defined visual enclosure
- Limits of visibility sector (area within major visual enclosure, but with restricted visual access)
- Portal-visual access into visibility sector or adjoining visual enclosures
- Major visual feature, with principal viewing direction from highway
- Highway visible from major use area
- Highway constitutes potential visual intrusion

Areas requiring detailed landscape architectural input:

- Major cuts and fills
- River, TCH interface
- Potential alignment changes for visual enhancement

VISUAL ANALYSIS
INITIAL ASSESSMENT

Sheet 1

FIGURE 3.9-1

VISUAL ANALYSIS
INITIAL ASSESSMENT

Sheet 2

FIGURE 3.9-1

Lake Louise Ski Area

Extensive views of the highway corridor between Lake Louise and Castle Mountain Junction are available from the Lake Louise ski area. Most of the ski area, including the Whitehorn Lodge, is at least 5 km distance from the highway, and thus all but the most major landscape alterations have insignificant visual impacts. Nevertheless, the highway is visible to skiers and summer sightseers using the gondola lift.

Sulphur Mountain

The Sulphur Mountain Gondola Lift offers a significant Park experience for visitors. From this point many tourists enjoy their first, and often only, panoramic view of the Canadian Rockies. The view includes the southeast part of the project area up to approximately km 31 and to some, as at Lake Louise, the highway constitutes an intrusion on the landscape. However, it also is several kilometres distant, and most would accept its presence without comment.

Trails

Although there are several major trails in this section of the Bow Valley, there are only very limited views of the highway from most of these trails. This is because they are located along heavily-forested tributary valleys and they do not pass out of the trees until they are well into cirques or hanging valleys from which much of the valley floor is not visible.

The Castle Cliffs trail offers the most complete views of the Bow Valley; it is not, however, a heavily-used trail. The trails in the Agnes Lakes/Beehive area and the Saddleback trail are popular trails in the Lake Louise area that offer extensive views of the north end of the valley. However, the highway corridor beyond a point about 4 km southeast of Lake Louise village is concealed by topography .

3.9.4 CONCLUSIONS

In terms of the views from the highway the visual experience of travelling the section of the TCH west oc Castle Mountain Junction tends to be monotonous west of Castle Mountain Junction. This is the result of limited viewing opportunities of the background landscapes, an absence of well-composed landscape views, and lengthy straight highway sections through a uniform and unchanging forest corridor.

Visual impacts of the present highway when viewed from distant points are not severe, and revegetation success has generally been good. There are, however, some impacts that could benefit from mitigation efforts. These include a number of cut slopes with poor revegetation or unnatural appearances, including a major rock quarry site. There are also numerous borrow sites, some with unnatural rectangular shapes, which could be mitigated in terms of both revegetation and aesthetic configuration. Further, some sections of the river adjacent to the highway presently have unnatural-appearing banks, a result of regrading during construction.

SECTION 3.10

SOCIO-ECONOMICS AND TOURISM

3.10.1 STUDY REGION

For purposes of this analysis the study region covers a broad area encompassing the communities of Banff, Lake Louise and Canmore.

Reference should be made to the Phase II EIS for an account of the historical development of the region.

3.10.2 POPULATION

Table 3.10-1 presents census population data for the communities of Canmore, Banff and Lake Louise, as derived from Statistics Canada.

Canmore

Canmore's population has been increasing steadily since 1966, with average annual growth being 3.2 percent. Since 1974, growth has been much more rapid, averaging in excess of 10 percent per annum. Much of the recent growth in Canmore and Harvie Heights is related to 2 major factors:

(i) the difficulty of obtaining permanent accommodation in Banff;

(ii) the demand for recreational homes in close proximity to Banff National Park and Kananaskis Country.

Banff

Within the Park, the number of permanent residents has increased since 1966 at an average rate of 1.6 percent per annum. Banff's population accounts for the majority of residents in the Park - approximately 91 percent in 1981. Banff has grown at an annual rate of 2.4 percent since 1966.

Lake Louise

The permanent population at Lake Louise has varied between 121 and 335 residents since 1966, and represents 7.7 percent of the total population in the Park.

Seasonality

During the summer season, the population of Banff greatly increases with the influx of visitors and seasonal employees. Approximately 1500 temporary employees reside in the community during the summer months (Parks Canada). Total summer population estimates range between 10,000 and 20,000 (Phase II EIS).

A similar phenomenon occurs during the winter season but to a much lesser degree. About 800 non residents are employed during the winter season. Because they are not permanent residents of Banff, seasonal workers are not included in the population figures (Parks Canada).

TABLE 3.10-1: HISTORICAL POPULATION, 1961-1981

	1961	1966	1971	1976	1981
Canmore (1)	1936	1548	1734	2123	3643
Banff	-	2896	3219	3410	4208
Lake Louise	-	121	165	140	355
Banff National Park	4101	3381	3532	3849	4627

- not available

(1) Population of Harvie Heights is included for 1966, 1971, 1976 and 1981.

3.10.3 REGIONAL ECONOMIC ACTIVITY

The major elements of the regional economy, aside from tourism which is treated separately (Sections 3.10.4 and 3.10.5) are described in this section. Prevailing policies preclude commercial extraction of resources and production of manufactured commodities within the Park. This affects such economic sectors as agriculture, forestry, mining and manufacturing.

Agriculture

Production of crops and livestock is minimal in that part of the study region lying outside of the Park. A combination of mountainous terrain and poor soils basically accounts for absence of commercial agriculture activity.

Forestry

Some timber harvesting is currently underway in the vicinity of Spray Lakes Reservoir, south of Canmore. This timber is transported by truck to processing facilities at Cochrane. Forestry, like agriculture, is of minor importance in the regional economy; this is borne out by census figures which indicate that the labour force in forestry declined from 148 in 1961 to 15 in 1971 (Phase II EIS). While more current figures are not available, it is estimated that the size of the forest sector labour force has changed little since 1971.

Mining

The presence of coal, limestone, ornamental stone and sand and gravel has led to the development of mining and quarrying operations which now follow tourism as an important sector in the region's economic base.

Up until 1979, Canmore Mines Limited, a subsidiary of Dillingham Corporation, operated three underground mines producing roughly 275,000 tonnes of raw anthracite coal annually for Japanese markets. Following mine closure in mid 1979, many of the 140 company employees and their families have stayed in Canmore and now work in other sectors of the regional economy. It is not expected that the mine will re-open unless new markets for the semi-anthracite coal are found, and until freight rates for transporting the coal are substantially reduced. Prior to closing, average operating losses for the company were about $100,000 per month.

East of Canmore are three major quarries and associated manufacturing facilities producing cement, lime and insulation material. While these activities are situated outside the study area they are included here because Canmore provides housing, commercial, community and social services for a part of the population employed in these industries.

Canada Cement Lafarge Limited operates a major quarry and cement manufacturing plant at Exshaw, 18 km east of Canmore. At Kananaskis, which is just east of Exshaw, Steel Brothers Limited operates a lime kiln, producing various grades of lime for use in industrial processes and the construction industry. At a site between Exshaw and Canmore, Alberta Rockwool Company Limited manufactures insulation material from shale and dolmite obtained from a nearby quarry.

The Banff Centre

Since its inception in 1933, the Banff School of Fine Arts, now called the Banff Centre, has developed into an institution for formal education - expanding in both size and concept.

Conference activities utilize over 50 percent of the Centre's space. Fine arts programmes are concentrated in the summer months and utilize approximately 30 percent of the Centre's capacity, with the remaining 20 percent being taken up with the Schools of Management and Environment. Roughly 35,000 people use the Centre's facilities each year; the majority are conference delegates (30,000) and the remainder are students.

The Banff Centre is one of the major employers of the study region, with a permanent staff of 300 employees. In the summer, the staff increases to about 400.

The Centre is capable of accommodating 600 staff and students in conventional housing (staff) and dormitories (students). Approximately 30 to 40 percent of the permanent staff live in Canmore and Harvie Heights and commute to Banff daily (Phase II EIS).

Public Administration

Parks Canada is a major source of employment in the study region. Approximately 280 permanent staff are engaged in the management of the Park as a whole. Their activities cover a wide range of adminstrative functions, including the management of Banff and Lake Louise visitor service centres (townsites), visitor services, management and maintenance of park facilities, and the administration of property leases. Parks Canada hires an additional summer staff of 200 employees in order to cope with the influx of park visitors.

The vast majority of the permanent staff live in Banff. The seasonal park staff is also housed within the Park.

Public administration is of minor significance in Canmore's economy, accounting for only 5.4 percent of total employment in 1975 (Calgary R.P.C., 1977).

3.10.4 TOURISM

Banff National park continues to be a major tourist destination as well as providing recreational opportunities in a regional context. Tourism is the basis of economic activity within the Park, and is characterized by seasonal fluctuations, and a dependency on external factors such as the value of the Canadian dollar relative to foreign currencies, fuel costs and weather conditions.

Park Visitation

Visitation has fluctuated between 2.3 and 3.8 million annual attendance during the past 15 years, and has remained above the 2.6 million level since 1973/74. Park visitation experiences peak during the year, notably during the summer. Winter peaks also exist, and have been increasing in magnitude. Visitor origins change with the seasons as well, with more out-of-region visitors entering the Park during the summer. In general however, visitation has experienced a decline in the past 3 years, with a resulting impact on user-day statistics and revenue. This is presumably due to the economic recession in Canada and especially in the Calgary area.

Summer Recreation

Participation in recreational activities in the Park has been documented by Irwin (1975) and more recently by the IBI Group (1978). In Banff, eating and sightseeing were found to be the most prevalent activities followed by shopping and resting. In Lake Louise, 85 percent of visitors surveyed mentioned sightseeing as an activity, 33 percent serviced their vehicles, and 30 percent frequented restaurants. These figures clearly indicate the role of Lake Louise as a service centre. In Banff, less than 5 percent of visitors participated in hiking or horse-back riding; in Lake Louise roughly 20 percent did so. These studies suggest that backcountry actitivies, nature walks, and attending interpretive programs, although important to those who participate, play a relatively minor role in Park usage. The automobile, on the other hand, figures prominently in the summer visitors' use of the Park. Irwin reported that roughly 77 percent of Park visitors were tied to their automobiles for most of the day, some driving around Banff, others to Lake Louise and attractions on the Banff-Jasper and Yoho Highways.

Skiing

Downhill skiing in the park grew at an annual rate of 13.2 percent between 1970 and 1980. The 5 ski resorts in the Park and adjacent areas accounted for a total of 970,000 skier-days in the 1983/84 season (Travel Alberta, 1985).

Calgarians make up the majority of skiers using the skiing facilities in the Park, and primarily make day trips on the weekends. Promoters of ski vacation packages attempt to schedule around major holidays and weekends to avoid overcrowding on the slopes and the accommodation. Opportunities exist for further expansion of ski-week vacation packages, and these are being actively promoted in the United States, Japan and eastern Canada.

Cross-country sking is also popular. In 1975/76, an estimated 6 percent of Calgarians participated in cross-country skiing, representing a total of 235,000 skier-days that year. Of these, approximately 60 percent chose to ski in mountain areas, 25 percent in urban areas and 15 percent in the foothills (Travel Alberta, 1977). A parks Canada survey in 1979 attempted to measure the extent of cross-country skiing in the Park. The results of this survey suggested total cross-country skiing activity of between 160,000 and 200,000 skier-days in 1979. Most of this activity occurred on weekends and holidays when as many as 3,000 skiers per day were recorded (Parks Canada). More recent surveys have not been conducted.

3.10.5 ECONOMIC VALUE OF TOURISM

Visitor Accommodation

Visitor accommodation in the study region is provided by 67 establishments which account for roughly 4400 rooms. Of this, Banff provides 51 establishments, which represent 3986 rooms (1984, Travel Alberta).

While most hotels and motels now operate on a year-round basis, some establishments are open only during the summer season. For the region as a whole, winter room availability is approximately 80 percent of the summer supply. Lake Louise shows the most marked difference between summer and winter room availability. During 1984, the potential supply of commercial visitor accommodation in the study region totalled over 1.3 million room-nights.

In 1983, visitor accommodation facilities in the study region operated at approximately 63 percent capacity. As one would expect, occupancy is very high during the summer season.

The availability of hotels and motels to accommodate increasing numbers of visitors during the summer months will be severely constrained unless additional accommodation is developed. Winter and off-season occupancy rates are lower than the annual average, but promotion of downhill skiing and other off-season vacations and convention business is expected to result in increased occupancy and hence improvement in the overall utilization of accommodation facilities.

During 1982, accommodation services in Banff National Park accounted for gross revenues of over $52 million, with food and beverages in the services sector contributing over $24 million (Travel Alberta, 1985).

Campgrounds

Summer campground utilization in the Park showed a downward trend between 1979/80 and 1982/83, and slight increases in 1983/84, with a range of 182,000 - 217,000 campsight nights. Overflow camping has experienced similar trends, showing a range of 11,000 - 30,000 campsite nights.

Winter camping has experienced a slight upward trend, with a range of 7,4000 - 8,4000 campsite nights.

Data on use of Canmore camping facilities is provided from the Phase II EIS. Campground facilities in Canmore contributed an estimated 20,100 campsite-nights during 1979; this is roughly equivalent to an occupancy factor of 55 percent on an annual basis.

In total, campground utilization throughout the study region amounted to just over 219,800 campsite-nights during 1979.

Gross revenue accuring to Parks Canada from use of campground facilities in the Park totalled $723,100 during the 1979/80 fiscal year. Of this total the revenue generated by Parks Canada campgrounds within the study region is in the order of $665,250. The privately operated campground facilities in Canmore are estimated to have generated roughly $120,600 of revenue during 1979. Thus camping facilities accounted for an estimated $785,850 of gross revenue in 1979. These revenues would likely show a decreasing trend since 1979/80, reflecting the user statistics.

Retail and Service Trades

The development of retail and service business in Banff, Lake Louise and to a lesser extent Canmore, has been prompted largely by the growth of tourism. It is important to recognize, however, that certain facilities serve the resident population of these communities as well as visitors. This dual function means that residents benefit from certain goods and services which are provided primarily to serve visitors. For example, particular types of retail and service establishments are found in Banff which one would not expect in a community of its size.

It has been established that Banff is the primary retail and service centre in the study area. In the Banff Commercial Study, conducted in 1976 by the Sussex Group, the impact that tourism has upon the supply of retail and service trade establishments was illustrated. Banff was compared with 17 communities of similar size in other parts of Alberta. In terms of retail trade, Banff has over twice as many establishments as other communities of comparable population. Similarly, disproportionately more service trade establishments are located in Banff than comparable communities - roughly three times as many.

The availability of retail and service establishments in Lake Louise is primarily attributable to tourism, since the small resident population would not justify the scale of development observed.

Retail and service outlets in Canmore are concentrated in the main core of the town and in a linear development along a service road to the TCH. Many automotive and food service establishments serve highway travellers and hence are located near the TCH.

During 1982, total retail sales contributed approximately $150 million to the regional economy. While the significance of tourism cannot be measured precisely because figures of total regional income are unavailable, it is possible that tourism could account for roughly 75 percent of total income within the study area. Within a provincial context, regional tourism revenue comprises roughly 10 percent of total provincial tourist spending.

The economic significance of tourism can also be shown using employment and payroll figures for the retail and service trade sectors. It was estimated for 1979 that 3300 jobs and $21.4 million of wage and salary income could be ascribed to tourist activity. Due to the seasonal characteristics of tourism, the employment pattern in these sectors is quite variable over a year. Many jobs, especially those during the peak summer period, are filled by persons from outside the study region. Students are an important source of labour during the summer months.

In summary it is clear that tourism plays a vital role in the economy of the area and there is no evidence to suggest that this pattern will change in the foreseeable future. In fact, internal and external factors could further enhance the tourist economy. Facility improvements which are planned, such as the Lake Louise Visitor Centre, are expected to attract an increasing number of visitors to the region, and therefore generate a positive economic impact. The future growth of Alberta, and more particularly Calgary, combined with increases in real personal income, leisure time and enhanced public awareness of the natural attributes of the study region, will all play a positive role in the future growth of the region's tourist industry.

4

Applicable Administrative Procedures
and Regulations

SECTION 4.1

PREVIOUS ENVIRONMENTAL ASSESSMENTS

In May 1978, Public Works Canada (PWC) referred the proposed twinning of the Trans Canada Highway (TCH) from East Gate to Sunshine Road to the Federal Environmental Assessment Review Office (FEARO). This action was taken by PWC because:

a) An initial environmental evaluation (IEE) carried out prior to 1978 showed a potential for significant environmental effects; and

b) Four-laning a highway through a national park lacked precedent, and it was felt that public concern about the proposal was such that a public review in the form of a Panel hearing was desirable.

In 1979, following the preparation of the Environmental Impact Statement (EIS) for the section from East Gate to km 13 (Phase I), the hearing was held and the Panel subsequently submitted their recommendations to the Minister of Environment that the project proceed with certain qualifications. One of these qualifications was that "a committee be constituted as a mechanism to ensure that highway design and construction meet the high environmental and aesthetic standards necessary in the Park. Membership to include representatives from Public Works Canada, Parks Canada, and the Environmental Protection Service....."

In 1981, PWC submitted an EIS covering Phase II, km 13 to Sunshine Road, and in early 1982 a second formal Panel hearing was held. The Panel recommended that four-laning the highway from km 13 to km 23 (the Bow Valley Parkway junction) proceed but that a decision on twinning of the TCH beyond km 23 be postponed pending further study[1]. These studies were subsequently carried out by PWC and Parks Canada and later in 1982 they jointly agreed to proceed with construction up to km 27. During the hearing the Panel was informed of the committee structure for Phase I and the role of the Environmental Coordinator (Section 4.2). The Panel recommended that a similar committee structure would be appropriate for Phase II and endorsed the duties of the Environmental Coordinator.

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1 The studies comprised completion of an evaluation of the Bow Valley Parkway as an alternative to twinning, and further development of an overall concept for transportation requirements covering the remaining sections of the TCH within the Park.

2 Refer p. 71 of FEARO report dated October 1979.

Throughout these procedures, PWC served in the role of both the initiating department and the proponent. This was clearly stated in the initial guidelines prepared by FEARO (1978) covering the preparation of the EIS[2]. The definitions and responsibilities of the "initiating department" and the "proponent" are provided in the Environmental Assessment and Review Process (EARP) Guidelines Order (June 1984). In this context Parks Canada acted in the role of an "other department" with the specific responsibility to protect the resources and manage the land.

SECTION 4.2

ENVIRONMENTAL MANAGEMENT OF CONSTRUCTION TO DATE

4.2.1 CONSTRUCTION TO DATE

Phases I and II

PWC informed the 1982 Panel hearing covering Phase II that construction was expected to continue until 1990, making a total construction period of Phases I and II of some 9 years. The Panel recommended that "the construction period be shortened to reduce disruption to the Park, provided environmental protection scheduling requirements are respected". The actual construction schedule is summarized below:

a) Phase I commenced 1981 and was largely completed 1984.

b) Phase II commenced 1983 and will be virtually complete 1985.

c) The Norquay Interchange was completed in 1984 and Minnewanka, Bow Valley Parkway, and Sunshine interchanges will all be completed by 1985.

Thus, the total construction period has been reduced to almost 5 years. This fast tracking, made possible by funds from the Special Recovery Capital Projects program, resulted in some problems with regard to environmental management of the work. Even so, those contacted were satisfied that the new highway has been constructed to high environmental and aesthetic standards. Indeed, a former member of the Panel (W.A. Ross) recently carried out an environmental review of the work and concluded in his report (July 1984) to FEARO that "on balance ..... the Banff Highway Project is an environmental success story". He stated however that fast-tracking had taxed the resources available for adequate environmental control and particularly queried if there was adequate time to review and approve detailed plans and construction procedures as they were developed. There is general agreement with this concern among those involved with the construction work.

Phase III

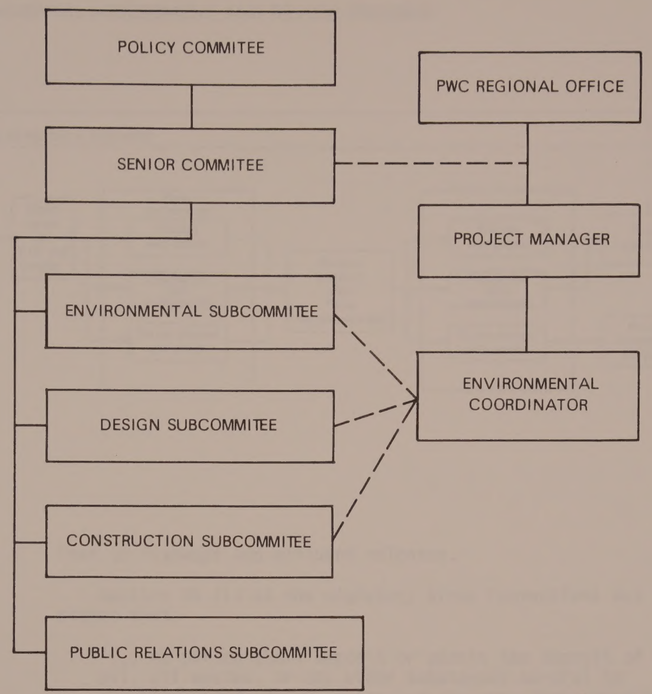
Construction of the Whitehorn Interchange at Lake Louise plus approximately 1 km of four-laned highway each side is presently underway and is expected to be complete by 1985. This work is being funded by Parks Canada as part of the development of the Lake Louise townsite and surrounding area. PWC as the common service agency for Parks Canada, designed a diamond-type interchange to serve the area. Parks Canada, as the initiating department, conducted an environmental assessment and concluded that a formal EARP review of the project was unnecessary.

A preliminary design of the Castle Mountain Interchange at the intersection of Hwy 93 has been prepared.

4.2.2 ENVIRONMENTAL MANAGEMENT OF PHASES I AND II

At both hearings the Panel recognized that a formal review can cover only the justification of the need of a proposal and such environmental impacts as are evident from a conceptual design. The Panel further recognized that other impacts would become apparent during design and construction and, more importantly, that resolution and mitigation of these impacts could best be handled through on-site supervision. Accordingly, PWC recruited a full-time environmental coordinator residing at the job site (the former Chief Warden of the Park). PWC also established an environmental committee structure comprising six entities. This committee structure is shown on Figure 4.2-1. The Policy Committee comprises representatives from PWC, Parks Canada, and Environment Canada. To ensure that the policies and directives of this committee were met, a Senior Committee and four subcommittees were established (Environment, Design, Construction and Public Relations). PWC, Parks Canada and Environment are represented on the Senior Committee and all subcommittees. The Senior Committee coordinates and schedules the activities of the subcommittees and is also required to approve all recommendations of a major or controversial nature.

From the standpoint of environmental management of the project, it appears that the Environmental Subcommittee has been the most active. In particular, a good and meaningful working relationship has been established between this subcommittee and project management. This committee appreciates the need to be informed of field facts and makes regular visits to the site. There is now little doubt that effective communication between PWC and Parks Canada exists on the project. This was an original concern of the Panel (FEARO, 1979, p. 39).



EXISTING COMMITTEE STRUCTURE – PHASES I AND II

FIGURE 4.2-1

SECTION 4.3

APPLICABLE ADMINISTRATIVE PROCEDURES AND REGULATIONS

This section briefly summarizes existing acts, regulations, guidelines and procedures that can apply to federal highway projects. It describes the legal and administrative framework within which Public Works Canada (PWC) and its agents can be expected to operate in the planning, design, construction and operation of the Phase III improvements.

Environment Canada

The Federal Environment Assessment Review Office of Environment Canada is responsible for the Environmental Assessment and Review Process (EARP) initially established by the Federal Cabinet in 1973 to ensure that:

a) Environmental effects are taken into account early in the planning of new Federal projects, programs and activities.

b) An environmental assessment is carried out for all projects which may have an adverse effect on the environment before commitments or irrevocable decisions are made; projects with potentially significant environmental effects are submitted to the Department of Environment for review.

c) The results of these assessments are used in planning, decision-making and project implementation. (Environmental Assessment Panel, 1977).

Since EARP was first established the initial phase has been based on self-assessment (screening) by the initiating department to determine whether or not a proposal should be referred to FEARO for formal public review. The process has been and still is an administrative procedure, not legislation. One persistent criticism has been that the initial screening phase is not a well-structured documentable process consistently applied across government (Environment Canada, April 1984). A new EARP Guideline Order issued June 1984 constitutes an attempt to have the initial screening undertaken in a more systematic manner. The initiating department is now required (Clause 16) in consultation with FEARO to establish written procedures for the initial screening phase, and provide FEARO with information on the implementation of these procedures with respect to proposals. FEARO is required to publish regularly a summary of the information provided to it by the initiating departments (Clause 18c). Other than this no significant changes to the process have been made which are pertinent to Phase III.

The procedure is summarized in Figure 4.3-1. A proposal is referred to FEARO for formal public review if:

- there are potentially significant bio-physical and social impacts; and/or

SCHEMATIC DIAGRAM OF THE FEDERAL ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS

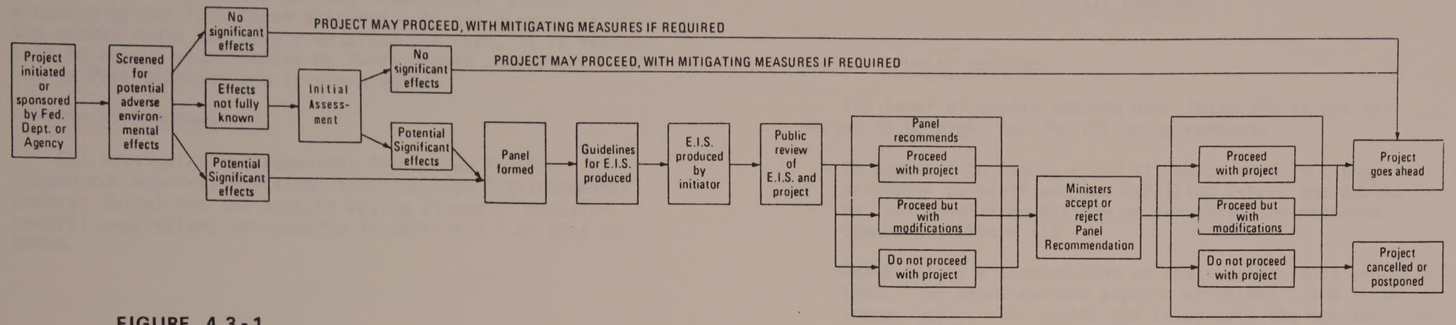


FIGURE 4.3-1

- there is significant public concern about the proposal.

Significantly, there is no specific requirement that FEARO review or approve the results of the initial screening process.

In accordance with the above procedure, PWC prepared an Environmental Screening report (April 1985) which was reviewed by the Senior Committee of the TCH Improvements Project. It concluded that an Initial Assessment (formerly called an Initial Environmental Evaluation or IEE) was warranted.

Environment Canada also administers two Acts that apply to specific aspects of highway development; these are the:

1. Fisheries Act, and
2. Migratory Birds Convention Act

The operative sections of the Fisheries Act are:

Section 31 (1):

"No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat."

and Section 33 (2):

"... no person shall deposit a deleterious substance of any type in water frequented by fish ..."

Various regulations, guidelines and Orders-in-Council under the Fisheries Act deal with gravel removal, obstructions to fishways and effluent releases.

Section 35 (1) of the migratory Birds Conventions Act states that:

"... no person shall deposit or permit the deposit of oil, oil wastes, or any other substances harmful to migratory birds in any waters or any area frequented by migratory birds."

In addition to these Acts, the Environment Protection Service has released various guidelines and protection measures that relate to specific elements of highway development, these are:

1. Asphalt Paving Industry National Emmission Guidelines 1975, under the Clean Air Act.
2. Environmental protection Measures for Highway Camps (Curran et al. 1976).
3. Guidelines for Fish Passage through Cluverts (Curran et al. 1976).

Health and Welfare

The Department of Health and Welfare has responsibility for inspection and approval of all workcamps operated by Public Works Canada and its contractors. The Department of Health and Welfare uses the standards set forth in Provincial regulations under the overall authority of the Public Works Health Act. These requirements relate to:

- Potable water systems.
- Refuse and garbage disposal.
- Heating and ventilation of dwellings.
- Vermin protection.
- Sewage disposal.
- Washroom, kitchen and eating sanitation.
- Rubbish and litter control.

Parks Canada

Parks Canada has jurisdiction over the natural resources within Banff National Park. Section 7 (1) of the National Parks Act allows for regulations to be made covering a wide range of activities within a National Park.

Regulations pertaining to highway construction are described in the sections of the National Parks Regulations concerned with: Fishing, Ice Removal, Game, Forest Protection, Timber, Buildings, Highway Traffic and General Matters.

These regulations govern:

- Environmental protection.
- Disposal of waste materials.
- Blasting and the storage of explosives.
- Storage of fuels.
- Clearing of rights-of-way, and removal of timber.
- Erection of buildings.
- Removal of ice from streams and lakes.
- Use of water.
- Building codes; including electricity, sewage and water.
- Licensing of vehicle operators.
- Erection of traffic signs.
- Traffic within the Park.
- Possible harrassment or molesting of fish and game.

Regulation 7-14 (1) states that:

"every person in charge of a touring party or work party shall provide himself with a copy of these Regulations and shall ensure that each member of his party is acquainted with and complies with these regulations."

Because there is no permit or licensing procedure for

land uses such as highway development within a National Park, permission would be at the discretion of the Park Superintendent. The Park Warden Service is the enforcement agency for the Park Regulations and any requirements placed on development by the Park Superintendent. As the highway is also the access route for people entering the Park, it is reasonable to expect requirements by Parks Canada on matters relating to Park planning and interpretation.

Alberta Environment

The Provincial Environmental Protection Service (Standards Approval Division) have compiled "Environmental Control Guidelines for Asphalt Paving Plants". Emission control regulations are covered in Section 4.1 of this document.

SECTION 4.4

PHASE III PROCEDURE

4.4.1 PUBLIC CONCERN

The level of public concern over Phase III is not expected to be high, for the following reasons:

- In contrast to Phases I and II, which were in close proximity to Banff and the Vermilion Lakes, the public has not identified any new or sensitive environmental concerns in Phase III.

- Phase III is a continuation of construction that began in 1981. The unprecedented aspects of Phases I and II no longer apply. The public has lived with the construction work and has seen the results. There has been little reported negative response.

- The management of the project (including environmental management) and communications with the general public have been good.

Thus unless "potentially significant" environmental impacts are revealed by the Initial Assessment a formal review involving a public hearing is unwarranted.

4.4.2 PUBLIC CONSULTATION

The public will have the opportunity to review the Initial Assessment. The final document will be made available to all interested parties, from an existing list available through the Parks Canada Planning Program. Further public consultation will be dependent on expressed interest in the proposal covered by the Initial Assessment.

4.4.3 PROPOSED ENVIRONMENTAL MANAGEMENT

Public Works Canada will retain the same environmental committee structure as was developed for Phases I and II. The position of the Environmental Coordinator responding to the Project Manager will be maintained. It is anticipated that many of the personnel involved with environmental management of Phases I and II will go on to Phase III, thus ensuring continuity.

Detailed environmental studies as identified in the sections entitled "Additional Work" in Part 5 of this Initial Assessment will be undertaken on a sector by sector basis, as part of detailed design. Specialists from the private and public sectors will be utilized.

5

Environmental Impacts and Mitigating Measures

SECTION 5.1

TERRAIN

The proposed highway improvements will impact the terrain, primarily through expansion of existing sidehill cuts and construction of new ones.

5.1.1 POTENTIAL IMPACTS

At this time, the extent to which the existing cuts will be enlarged, and the likely size of the new cuts, is not known in detail. It is anticipated however that the improvements will generally result in some enlargement, both horizontally and vertically, of the majority of existing cuts and the construction of a number of new cuts east of Lake Louise, and in a possible southern alternative, west of the Sunshine Turnoff. A detailed description of the expected construction conditions together with the existing cut conditions is provided in Table 5.1-1, for the alignment described in Section 2.2-1.

In general, it is expected that most of the cut slopes will perform satisfactorily. However a number of existing slopes are unstable because of seepage, and others are eroding because they are over-steep, lack vegetation, and expose fine materials. Without suitable mitigative measures, these conditions could be exacerbated by the proposed improvements.

5.1.2 OPPORTUNITIES FOR MITIGATION

For construction of the existing cuts, slopes ranging from steeper than 1.5H:1V to 2H:1V and occasionally 3H:1V were adopted. As noted on Table 5.1-1, the performance of the majority of these cuts has been satisfactory. In most instances the cuts are dry and little surface sloughing has developed. Revegetation of the slopes appears to be good. Very shallow sloughing exists on some till slopes cut at between 1.5H:1V and 2H:1V.

At two locations shallow rotational and flow sliding has developed, along the south side of Highway 93, west of Castle Mountain Interchange, and along the existing TCH in the vicinity of km 65. It appears that both slopes, developed in till, were initially constructed at slopes of 2H:1V or steeper. In both instances, perched groundwater table conditions exist and the cuts are wet. It is concluded that the overly-steep slopes for the till materials encountered and adverse (high) groundwater conditions have contributed to development of these failures.

This review of existing sidehill cuts and their performance suggests that for many of the proposed new cuts, implementation of similar construction procedures will suffice. These will consist of excavating sidehill cuts in soil (till, alluvial fan debris and sands and gravel) at slopes of about 2H:1V, and treating bedrock cuts on a site specific basis.

TABLE 5.1-1: EXISTING AND PROPOSED SIDEHILL CUTS

LOCATION (km)	EXISTING CONDITIONS	EXPECTED CONSTRUCTION CONDITIONS	COMMENTS
26.4 - 26.7	10 m high, near vertical cut; massive limestone, with shallow veneer of till/ colluvium; dry; stable	-	Not impacted by proposed improvements
26.75 - 26.9	4 m - 5 m high, near vertical cut; thin, medium bedded limestone, with shallow veneer of till/colluvium; dry; stable; good revegetation	-	Not impacted by proposed improvements
27.4 - 27.6	4 m (N) to 10 m (S) high cuts, at about 2H:1V; gravelly till, no bedrock exposed; dry; stable; good revegation	Similar conditions anticipated in proposed cut	Future cut to N
27.9 - 28.5	10 m to 12 m high cut; at about 1.5H:1V; gravelly till, no bedrock exposed; dry; some small sloughs; fair to good revegetation	Similar conditions anticipated in proposed cut	Future cut to N; existing sloughing likely due to steep slope and possible minor seepage
28.8 - 29.3	2 m to 3 m high cut, at about 3H:1V; gravelly alluvial fan material, no bedrock exposed; dry; stable; good exposed; dry; stable; good revegetation	Cut in gravelly alluvial fan material; stable; dry; similar along S alternative	Future cut to N; possible alternative to S; future cuts could be steeper
29.8 - 31.0	10 m to 12 m high cut, at 2H:1V and steeper; gravelly till, locally underlain by massive limestone (extending up to 4 m above existing TCH grade); dry; some sloughing on steeper slopes; fair to good revegetation	Gravelly till cuts, locally with bedrock in toe areas; likely more bedrock along S alternative	Future cut to N; possible alternative to S; maintaining cuts at 2H:1V would likely reduce sloughing (natural hillside is at 2H:1V approximately)
31.3 - 31.5	5 m (N) to 15 m (S) high cuts, about 1.5H:1V and steeper; very coarse alluvial fan debris (blocks to 2 m+); dry; stable; fair revegetation	Bouldery alluvial fan material; dry; stable; fair revegetation	Future cut to N; possible alternative to S; similar conditions anticipated along both routes; difficult excavation; possibly some bedrock in toe areas
31.9 - 32.2	Up to 8 m high cut, at about 2H:1V; thin to medium bedded limestone, overlain by 1.5 m to 2.5 m gravelly till; dry; some ravelling of jointed bedrock; good revegetation	Gravelly till underlain by jointed bedrock; ravelling expected, due to unfavourable structure (bedding dips out of cut); dry	Future cut to S; similar conditions anticipated along S alternative, possibly more bedrock
32.4 - 32.6	7 m to 8 m high cut, at about 2.5H:1V; sandy angular gravel alluvial fan material, no bedrock exposed; some minor seepage; stable; good revegetation	Gravelly alluvial fan material along future cut; bedrock not likely; possibly some seepage; stable	Similar conditions along S alternative

However, where high groundwater conditions exist, implementation of special measures to control groundwater (likely also involving a reduction in cut slope angles) will be necessary. Where side slopes are stripped and excavated, revegetation will be undertaken as soon as possible.

5.1.3 ADDITIONAL WORK

An additional ground survey similar to that carried out for this Assessment will be required for consideration of an alternative southern alignment.

For the alignment described in Section 2.2, the two areas that exhibit rotational and flow sliding in glacial till warrant further investigation and analysis. Field observations suggest, in these instances, that the failures are related to adversely-high groundwater conditions in combination with overly-steep till cut slopes. Additional studies will be directed towards confirming this preliminary conclusion and developing procedures whereby future problems in these areas may be avoided or minimized. This work may involve field investigations to determine soil and groundwater conditions, together with analyses to determine optimum cut slope angles and configurations, and procedures for groundwater control.

5.1.4 SUMMARY

Enlargement of existing sidehill cuts and construction of a number of new cuts, to accommodate proposed improvements to the TCH are identified as the most significant adverse impacts on terrain. It is concluded that implementation of selected remedial measures and mitigative procedures adopted for Phases I and II, as well as those used during the original construction of this section of highway, will do much to address these concerns.

Two areas, near Castle Mountain Interchange and in the vicinity of km 65, exhibit evidence of shallow rotational and flow sliding. These failures are related to adverse (high) groundwater conditions in combination with overly-steep cut slopes. Further work is recommended with respect to mitigating the current problems at these locations.

An additional ground survey will be required for an alternative southern alignment.

TABLE 5.1-1: EXISTING AND PROPOSED SIDEHILL CUTS

LOCATION (km)	EXISTING CONDITIONS	EXPECTED CONSTRUCTION CONDITIONS	COMMENTS
32.8 - 33.2	6 m to 7 m high cut; sandy gravel alluvial fan material, with thin to medium bedded limestone at W end (extending up to 5 m above TCH grade); dry; some ravelling of bedrock; fair to good revegetation	Similar conditions expected along future cut on S; ravelling expected due to unfavourable bedrock structure (dips out of cut)	-
33.7 - 34.05	5 m to 6 m high cut; gravelly to bouldery alluvial fan material, underlain by 2.0 m to 2.5 m of thin to medium bedded limestone; dry; some minor ravelling; good revegetation	-	Not impacted by future improvements
37.5 - 37.6	Existing cut, some 50 m to W, exposes 2 m of medium bedded limestone, overlain by gravelly till; stable; dry; good revegetation	Similar conditions anticipated in proposed cut	Existing exposures are poor
39.0 - 39.3	Approximately 20 m high cut, at about 1.5H:1V and locally steeper; gravelly till, no bedrock exposed; dry; minor sloughing in upper part; good revegetation	Similar conditions anticipated in proposed cut	Slopes of 2H:1V will eliminate sloughing
41.0 - 41.2	Existing 15 m cut, at about 2H:1V and steeper; gravelly in steeper toe area; good revegetation	-	Not impacted by future improvements
41.4 - 41 7	Up to 5 m high cut; gravelly till, no bedrock exposed; dry; stable; good revegetation	Similar conditions anticipated in proposed cut	-
42.6 - 42.8	6 m to 7 m high cut; gravelly till, no bedrock exposed; dry; generally stable, small sloughs at west end; good revegetation	Similar conditions anticipated in proposed cut	3 m - 4 m cut in similar material to N
43.4 - 43.65	10 m to 12 m high cut, at about 1.5H:1V; very coarse, bouldery, alluvial terrace material; dry; stable; fair to good revegetation	Similar conditions anticipated in proposed cut	Existing cut is well back from TCH; may not be impacted
44.0 - 44.65	10 m to 12 m high, near vertical cut; massively bedded limestone, with shallow colluvial veneer; dry; some minor ravelling	Similar conditions anticipated in proposed cut	-

TABLE 5.1-1: EXISTING AND PROPOSED SIDEHILL CUTS

LOCATION (km)	EXISTING CONDITIONS	EXPECTED CONSTRUCTION CONDITIONS	COMMENTS
46.6 - 46.7	4 m to 5 m cut, at 2.5H:1V to 2H:1V; rounded sandy alluvial gravel, locally overlying phyllitic bedrock; stable; occasional small seepage zones; good revegetation	Similar conditions, possibly with more bedrock, anticipated in proposed cut	Cut is typical of several between km 45 and 47
West side, Castle Interchange (southwest side)	Up to 5 m high cut, at 2H:1V and steeper; gravelly till; poorly drained, extensive rotational sliding; poor revegetation	Similar conditions anticipated in proposed cut; stability could be improved by cutting back slope and/or improving drainage	Angle of repose of slide debris is about 3H:1V
48.1 - 48.4	-	Proposed slope will likely be in till; probably wet (due to small muskeg upslope); possibly some bedrock in toe area	Slopes of 3H:1V, and improvements to drainage will improve cut stability
51.35 - 51.5	Existing small cut till/colluvium; apparently shallow bedrock; dry; stable; good revegetation	Proposed cut in till likely with some slates; dry and stable	Cut is very poorly exposed
51.9 - 52.1	Existing, poorly-exposed, cut in till/colluvium, with bedrock in toe area; dry; stable; good revegetation	Similar conditions anticipated in proposed cut	-
55.5 - 55.7	Up to 3 m high cut, at 1.5H:1V or greater; gravelly till, no bedrock exposed, dry; stable; good revegetation area	Anticipate similar conditions in proposed cut; possibly some bedrock in toe	-
56.5 - 56.8	About 10 m high cut; gravelly till, no bedrock exposed; dry; stable; fair to good revegetation	Similar conditions expected in proposed cut	Adjacent to old borrow area
57.7 - 58.05	5 m to 6 m high cut, at about 2H:1V; gravelly till; some seepage zones; evidence of creep (in trees); good revegetation	Till slope, possibly with some bedrock; some seepage	-
58.2 - 58.55	4 m to 5 m high cut, at 1.5H:1V and greater; gravelly till; dry; stable; good revegetation	Similar conditions anticipated in proposed cuts	Area possibly previously used as borrow source
61.3 - 61.4	Up to 5 m high cut; gravelly till; dry; stable; good revegetation	Similar conditions expected in proposed cut; possibly some bedrock	-

TABLE 5.1-1: EXISTING AND PROPOSED SIDEHILL CUTS

LOCATION (km)	EXISTING CONDITIONS	EXPECTED CONSTRUCTION CONDITIONS	COMMENTS
61.9 - 62.3	Up to 10 m high cut; gravelly till, underlain by phyllite at west end (extending 3 m to 4 m above TCH grade); stable; some seepage zones; good revegetation	Gravelly till, underlain by slate; wet in places; generally stable	Existing cut is 20 m to 40 m from TCH shoulder; may not be impacted
64.65 - 65.5	10 m to 15 m high cut, at slopes from 2H:1V to 1.5H:1V and steeper; gravelly till, underlain by fissile phyllite (extending up to 4 m above existing TCH grade); shallow rotational sliding and flow slides in places; locally wet; locally poor revegetation	Similar conditions anticipated in proposed cut	Stability could be improved by cutting back till slopes and draining cut
66.3 - 66.4	-	Slates (dipping out of cut), with 0.5 m till/colluvium; dry; possibly some ravelling of bedrock	Along proposed S alignment
66.5 ±	4 m - 5 m high cut, at 2H:1V; fissile phyllite, with less than 0.5 till/colluvium veneer; stable; dry; fair revegetation	-	Along existing TCH
67.1 - 67.2	3 m to 4 m high cut, at 2H:1V or steeper; medium-coarse sandy gravel, no bedrock exposed; dry; stable; re-vegetation fair to poor	Similar conditions anticipated in proposed cut	Existing cut is to N wall of gravel pit (Lake Louise overflow campsite)
67.7 - 67.9	-	Sandy gravel cut, bedrock unlikely; dry; stable	Existing cuts and old test pits (filled in) suggest alluvial terrace throughout
67.7 - 68.0	4 m to 5 m high cut, at 2H:1V; sandy gravel; dry; stable; good revegetation	-	Bedrock (quartzite) outcrops behind and upslope of cut
70.2 - 70.9	Up to 5 m high cut, at 2H:1V and steeper; fairly thick-bedded phyllite, with shallow till/colluvium veneer; dry; some ravelling; fair revegetation	Similar conditions anticipated in cuts	Bedrock is "blocky", due to widely-spaced joints
71.5 ±	6 m to 7 m high cut, at about 2H:1V; gravelly till, no bedrock exposed; dry; some minor sloughing; fair to good revegetation	Similar conditions anticipated in cut	-
73.95 - 75.0 (74.4 - 75.0 on S)	Up to 10 m high cut, close to vertical; fissile, jointed, phyllite; shallow till veneer; dry; ravelling; little or no revegetation	Similar conditions anticipated in cuts	Extensive ravelling due to bedding and jointing; likely easy excavation, by ripping

SECTION 5.2

STREAM REGIMES

5.2.1 POTENTIAL IMPACTS

Potential environmental impacts of the highway on streams and water bodies include:

(i) encroachments on the Bow River;

(ii) encroachment on wetlands in the Bow River floodplain;

(iii) blockage or constrictions of flood flows at crossings;

(iv) blockage or deterioration of fish passage at crossings; and

(v) increased runoff and contamination from paved areas.

The proposed alignment for the improved highway does not involve any further encroachments on the Bow River. At all points where the existing highway contacts the river it is presently the intention to locate the additional lanes to the south. In a few cases this will involve high steep cuts which may be environmentally undesirable. It may therefore be environmentally valid in one or two cases to consider an alternative location involving some encroachment on the river.

There are two areas of encroachment on existing wetlands. At km 27 to 28, the proposed new lanes will be located to the north and will encroach slightly on the wetland. At km 47 to 48, they will be located to the south, but there may be slight encroachments by ramps of the new interchange.

Blockage or constriction of flood flows at creek crossings can arise from provision of inadequate culvert or bridge waterway capacity, from temporary blockage by ice or floating debris, or from accumulation of stream bed sediment. There is no indication that existing culverts and bridges are inadequate or that serious problems have occurred along the existing highway with ice or debris blockage. Parallel second bridges are proposed for Moraine Creek and the Bow River (km 69.3) and no special problems are anticipated. On the Bow River crossing, a minor amount of channel re-alignment may be required to avoid skewing the piers of the new bridge. On the un-named creek at km 62.9, depending on the location of the additional lanes, it may be advisable to re-locate and channelize this stream in order to minimize the length of contact. In-stream maintenance has been required at Wolverine Creek and at un-named creek at km 35.5 to deal with accumulations of coarse bed sediment at or upstream of the crossings. At Altrude Creek and one or two other crossings, ice build-up tends to occur over the winter, backing up into picnic areas upstream of the crossings and delaying their use in the spring.

Consideration of fish passage is particularly relevant to Redearth Creek, Altrude Creek, Taylor Creek and Moraine Creek. At Redearth Creek and Moraine Creek, it is planned to duplicate the existing bridges which have ample waterway capacity and there are therefore no adverse implications for fish passage. At Taylor Creek, the existing culvert arrangement could probably be improved physically if it is shown that the stream has opportunities for fishery improvement.

The main concern from a fishery viewpoint is Altrude Creek. Preliminary plans for interchange improvements involve crossings of Altrude Creek by two interchange ramps as well as by eastbound and westbound lanes; also by a picnic ground access ramp near the present upstream culvert location. The initial proposal called for culverting of the creek through the main interchange over a length of 141 m. A report by Underwood McLellan Ltd. (1985) in association with Freshwater Research Ltd. discusses fishery aspects of this proposal and recommends the use of bridges or special culvert designs to reduce the impact on fish passage. Site inspection in May 1985 indicated the possibility of some diversion of the creek to the east to reduce the required length of culverting, or possibly to the west to permit separated crossings of the highway and the interchange ramps. A number of alternative layouts for this area should be considered in detail, in order to reduce the impact on fish passage in the creek.

As described in the Phase II EIS (Public Works Canada, 1981), surface runoff from the highway during rainstorms will not have any significant impact on stream flows. Sedimentation tends to be a problem during construction and early operation, until vegetation has been re-established on exposed soil surfaces. Because of the abundance of relatively coarse and permeable fluvial and glacio-fluvial materials, the study area is not particularly erosion-prone. Gravel mining in floodplains and channel zones can also lead to water quality problems during construction. Further, following completion of construction, problems can result from in-stream channel maintenance equipment, from salt and hydrocarbon contamination of road runoff, and from toxic spills.

5.2.2 OPPORTUNITIES FOR MITIGATION

Mitigative measures of hydrologic nature recommended or undertaken in Phases I and II of the highway improvements were mostly directed to impacts of stream crossings on aquatic habitat and fish. At Chinaman Creek a major diversion and channelization was installed and has apparently been effective. At Forty Mile Creek, bank stabilization by riprap has been carried out over several hundred metres of channel with a view to reducing the need for in-stream maintenance, but it is too early to assess the effectiveness of this work. Some problems were encountered in enforcing mitigative scheduling during construction. This type of problem can arise from unforeseen delays in obtaining third-party approvals, from unexpected ground conditions, or from contractual disputes.

If present plans for Phase III highway location are retained, there is no need to further consider mitigation of Bow River encroachments. As noted earlier however, there are opportunities to mitigate terrain impact at one or two locations where high sidehill cuts will result from locating the new lanes to the south. These comprise locating farther to the north and accepting some encroachment on the Bow River. Locations of particular interest are km 51.5 and km 55.5. At both those locations it appears that the river was re-channelized during the previous construction, and it now presents an unnatural canal-like appearance that represents poor aquatic habitat as well as being visually unattractive. If encroachment is carried out at these locations in order to mitigate terrain impact, the visual and habitat characteristics of the river will be improved through the channelized reach, in consultation with appropriate specialists.

The minor encroachments on existing wetlands proposed at km 27 to 28 and km 47 to 48 could only be mitigated by revision of the alignment. Because of geometric constraints at the Castle Mountain Interchange, this is probably not feasible at km 47 to 48.

Problems of coarse bedload accumulation and in-stream channel maintenance near creek crossings can be mitigated in some cases by providing channel stabilization measures in design and construction. This applies particularly where the bedload is derived mainly from channel shifting in alluvial fan accumulations in the vicinity of the highway. In these cases, stabilization of the channel using rock riprap upstream of the highway may reduce the problem. The possibility of such stabilization will be considered particularly at Wolverine Creek (km 29.6), at km 35.6, and at Moraine Creek (km 62.9).

Some existing culverts, such as at Taylor Creek have drops at their outlets. Wherever possible, these should be avoided as they tend to act as barriers to fish passage.

5.2.3 ADDITIONAL WORK

Records of previous construction and historical airphotos will be searched to find details of previous river alignments and re-channelization work at km 51.5 and km 55.5. Further consideration will be given to engineering and environmental aspects of re-location at these points, in order to compare the impacts of sidehill cuts with that of river encroachments combined with channel restoration.

Stream crossings that have required significant in-stream maintenance in recent years will be identified. Designs will be prepared for channel stabilization if analysis and site investigations indicate that this would reduce maintenance appreciably.

Maintenance personnel will be consulted and further investigations will be made regarding reported and observed icing conditions at Altrude Creek (km 46.8) and Taylor Creek (km 55.2) to ascertain if there are any possibilities for mitigation. Particularly in the case of Altrude Creek, the blockage of a considerable portion of the existing bridge by

ice in the spring, will be taken into account in sizing the extended structure required for the new Castle Mountain Interchange. Icing conditions would be particularly troublesome in a long unbroken culvert.

A number of alternative layouts will be considered for the Altrude Creek - Castle Mountain Interchange complex, in order to minimize the impact of the works on fish passage and habitat. Alternatives will include separated bridge crossings, separated large culvert crossings, and diversion of the creek to reduce the number or length of crossings. The inadequacy of the existing culvert crossing upstream of the highway, on the future picnic site access road, will receive further attention.

5.2.4 SUMMARY

Potential environmental impacts of the highway improvements on water bodies involve a number of contacts with the Bow River, contacts with two wetland areas, and crossings of some 16 streams including the Bow River near Lake Louise.

No further encroachments on the Bow River are presently contemplated, but there are two locations where these should be considered as alternatives to high sidehill cuts, at km 51.5 and km 55.5 approximately. There is an opportunity for improving previous re-channelization at these points.

Encroachments on wetland areas will be slight and cannot easily be mitigated.

The most significant stream crossing impact is at Altrude Creek in the proposed Castle Mountain Interchange. In order to avoid a long culvert crossing, alternative layouts, including a stream diversion alternative, will be considered. The problem of blockage by icings will be taken into account in sizing the bridges or culverts.

It may be possible to reduce in-stream maintenance at a few crossings by bank stabilization in the vicinity of the highway.

There is no evidence of problems such as debris torrents that require special measures in stream crossing design. The capacity of all existing stream crossing structures appears to have been adequate for flows experienced, and may in some cases appear excessive for expected flood flows. In view of the possibilities of blockage by ice, debris and coarse sediment, however, careful consideration will be given to any design that involves a reduction of existing capacities.

SECTION 5.3

AIR QUALITY

5.3.1 POTENTIAL IMPACTS AND OPPORTUNITIES FOR MITIGATION

Construction

Temporary localized increases in emission concentrations are expected, due to equipment working in a small area, particularly during periods of temperature inversion. In this regard, ensuring that all equipment is maintained in good operating condition is important.

Dust raised by construction activities or through the use of temporary unpaved detours will effect the particulate concentration in local areas. This problem will be mitigated through the use of water spraying and the temporary asphalt paving of certain (longer-term) detours.

All asphalt paving plants will comply with emission control regulations as detailed in Section 4.1 of the Einvironmental Control Guidelines for Asphalt Paving Plants issued by the Standards Approval Division, Environmental Protection Service, Alberta Environment.[1]

Temporary impacts on microclimate due to right-of-way clearing will be mitigated as revegetation activities are successfully undertaken.

Operation

Local air quality during operation of the new highway will be little changed, except for improved conditions during periods when traffic congestion would have otherwise occurred.

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[1] These guidelines are in accordance with Part 1, Section 6 of the Clean Water General Regulations, Alberta Statute 216-73, Part 1, and Section 4 of the Clean Air General Regulations Alberta Statute 216-75. The maximum particulate emmission level must not exceed 0.20 kg per 1,000 kg of effluent from all process sources.

SECTION 5.4

VEGETATION

5.4.1 POTENTIAL IMPACTS

The proposed improvements as described in Section 2.2 indicate that the new highway east of Castle Mountain Interchange will parallel the existing highway. This disturbance will be limited to a relatively narrow strip along the north or south side of the existing roadway. West of the Interchange, there is opportunity for several kilometres of widely separated eastbound and westbound lanes. Additional impacts will be created in the vicinity of interchanges and borrow pit areas.

Most of the area affected is within pine woodland and abandoned borrow pits which have very low vegetation significance. Of the vegetation types with higher significance, approximately 2.8 km of open wetland vegetation along the highway (mostly on the north side of the alignment) and 7.7 km of moist spruce woodland could be affected. Only 0.1 km of significant dry slope vegetation will potentially be affected. Most of the area is immature forest and no large specimen trees were noted in the field survey for this Initial Assessment.

Off-site or "downstream" impacts are possible if drainage patterns are disrupted through roads intercepting subsurface flow.

Table 5.4-1 identifies the principal vegetation types which may be affected and the potential significance of there impacts.

5.4.2 MITIGATION

Potential impacts on some of the more significant sites (Figure 3.4-1) could be avoided by slight shifts in the proposed highway alignment or through careful construction techniques. For example:

- A slight shift in highway alignment to the north at km 53.3 to 53.5 would eliminate any impacts on a wetland in that area. Vegetation to the north is a dry pine woodland.

- Restriction of all construction to strictly controlled areas would reduce or eliminate impacts at km 26.5 to 27.5 and along the north ramp (Hwy. 93) of the Castle Mountain Interchange. In addition, attention to the details of avoiding drainage distruption would further aid in conservation of these wetland habitats.

- Transplanting of significant species or re-creation of habitat through construction would mitigate impacts of highway construction at km 74.0 to 74.6, particularly in the area just east of the Icefields Parkway Interchange.

TABLE 5.4-1: POTENTIAL IMPACTS ON VEGETATION

APPROXIMATE LOCATION (km)	ECOSITES	PRINCIPAL VEGETATION AFFECTED	POTENTIAL SIGNIFICANCE OF IMPACT OF PROPOSED ALIGNMENT [2]
- North Side of Existing Alignment			
26.0 to 26.5	HD3	white spruce	L
26.5 to 27.5	VL3	white spruce, wetlands	H
27.5 to 28.0	PR2	pine	VL
28.0 to 28.4	PR2 (narrow)[1]/AT1	pine	VL
28.4 to 29.9	HD3	white spruce	L
29.9 to 30.5	PR2 (narrow)/VL3	pine/white spruce, wetlands	L
30.5 to 31.0	VL3	none	VL
31.0 to 31.1	IB1	pine	VL
31.1 to 31.2	VL3	white spruce, wetlands	L
31.2 to 31.6	IB1	alignment on south	VL
31.6 to 31.8	VL3	alignment on south	VL
31.8 to 31.9	IB1	alignment on south	VL
31.9 to 33.4	IB1	alignment on south	VL
33.4 to 33.8	PR2	pine	VL
33.8 to 33.9	VL3	white spruce, wetlands	L
33.9 to 34.0	FR1 (narrow)/VL3	pine/white spruce, wetlands	L
34.0 to 37.5	FR1	pine	VL
37.5 to 38.0	VL3	white spruce, wetlands	L
38.0 to 38.4	FR1	none	VL
38.4 to 39.0	BK4	pine	VL
39.0 to 39.8	VL3	alignment mainly on south	L
39.8 to 40.4	AL1	pine	VL
40.4 to 40.9	VL3	none	VL
40.9 to 42.2	PR6 (narrow)/VL3	pine/white spruce, wetlands	L
42.2 to 43.4	IB1	alignment on south	VL
43.4 to 43.9	BV1	alignment on south	VL
43.9 to 44.1	BK4	alignment on south	VL
44.1 to 44.8	HC1	alignment mainly on south	L
44.8 to 45.4	AL1	pine	VL
45.4 to 46.3	BK4	pine	VL
46.3 to 46.4	HC1	spruce, wetlands	L
46.4 to 46.7	BK4	pine	VL
46.7 to 46.9	AL1	pine	VL
46.9 to 47.1	BK4	pine	VL
	HC1 (north of interchange)	spruce, wetlands	M
47.1 to 47.7	HC1	spruce, wetlands	L
47.7 to 53.3	BV1	alignment on south	VL
53.3 to 53.4	AL1 (narrow)/BV1	alignment on south	VL
53.4 to 54.8	BV1	alignment on south	VL
54.8 to 55.1	VD2 (narrow)/BV1	alignment on south	VL
55.1 to 55.7	BV1	alignment on south	VL
55.7 to 56.7	AL1	alignment on south	VL
56.7 to 58.6	BV1	alignment on south	VL
58.6 to 61.1	AL1	alignment on south	VL
61.1 to 62.4	BV1	alignment on south	VL
62.4 to 63.0	VD2	alignment on south	VL
63.0 to 63.6	VD2 (narrow)/HC1	alignment on south	VL
63.6 to 64.9	VD2	pine	VL
64.9 to 65.9	HC1	spruce, wetlands	L
65.9 to 69.4	BV1	alignment on south	VL
69.4 to 70.1	VD2	alignment on south	VL
70.1 to 71.2	PR6	alignment on south	VL
Whitehorn			
73.4 to 74.0	BV1 (narrow)/BV2	pine	VL
74.0 to 74.2	BK4 (narrow)/BV2	pine	VL
74.2 to 74.6	BK4 (narrow)/BK1	pine	VL
74.6 to 75.5	BV1 (narrow)/BV2	pine	VL

APPROXIMATE LOCATION (km)	ECOSITES	PRINCIPAL VEGETATION AFFECTED	POTENTIAL SIGNIFICANCE OF IMPACT OF PROPOSED ALIGNMENT [2]
- South of Existing Alignment			
26.0 to 26.3	HD3	alignment on north	VL
26.3 to 26.5	BY2	alignment on north	VL
26.5 to 27.5	BK1	alignment on north	VL
27.5 to 28.6	PR2	alignment on north	VL
28.6 to 28.9	HD3 (narrow)/PR2	alignment on north	VL
28.9 to 29.6	HD3	white spruce	L
29.6 to 29.9	HD3	white spruce	L
29.9 to 31.0	PR2	pine	VL
31.0 to 33.4	IB1	pine	VL
33.4 to 34.0	PR2	pine	VL
34.0 to 35.0	BK4	alignment on north	VL
35.0 to 36.0	PR2	alignment on north	VL
36.0 to 37.5	BK4	alignment mainly on north	L
37.5 to 38.4	FR1 (narrow)/IB1	pine	VL
38.4 to 39.4	BK4	pine	VL
39.4 to 40.4	AL1	pine	VL
40.4 to 42.2	PR6	pine	VL
42.2 to 43.4	IB1	pine	VL
43.4 to 43.9	BK4	pine	VL
43.9 to 44.0	SB4	open forest, dry shrub, dry meadow	L
44.0 to 44.8	BK4 (narrow)/PR1	pine	VL
44.8 to 46.3	BK1	alignment on north	VL
46.3 to 46.4	HC1 (narrow)/BK4	alignment on north	VL
46.4 to 46.7	BK4	alignment on north	VL
46.7 to 46.9	AL1	alignment on north	VL
46.9 to 47.1	BK4	pine	VL
47.1 to 47.8	HC1 (narrow)/BK4	spruce, wetlands/pine, spruce, wetlands	L
47.8 to 48.3	BK1	pine, spruce, wetlands	L
48.3 to 48.7	BV1	pine	VL
48.7 to 50.3	BV1	pine	VL
50.3 to 50.5	BV1 (narrow)/BK1	pine	VL
50.5 to 51.3	BV1	pine	VL
51.3 to 51.5	BK1	pine, spruce, wetlands	L
51.5 to 51.7	BV1 (narrow)/BK1	pine	VL
51.7 to 52.2	BK1	pine	VL
52.2 to 52.8	BV1 (narrow)/VD2	pine	VL
52.8 to 53.3	BV1	pine	VL
53.3 to 53.5	AL1	pine, wetland	M
53.5 to 54.8	BV1	pine	VL
54.8 to 55.3	VD2	pine	VL
55.3 to 55.7	BK1	pine	VL
55.7 to 56.4	AL1	pine	VL
56.4 to 56.6	BK1	pine	VL
56.6 to 56.7	PR4	spruce-fir	L
56.7 to 57.7	BV1	pine	VL
57.7 to 58.6	PR4	spruce-fir	L
58.6 to 61.2	AL1	pine	VL
61.2 to 62.4	PR4	spruce-fir	L
62.4 to 62.9	VD2	pine	VL
62.9 to 63.3	VD2	pine	VL
63.3 to 64.8	VD2	pine	VL
64.8 to 65.5	BK4	alignment mainly on north	VL
65.5 to 66.3	BV1	pine	VL
66.3 to 66.4	BV1	pine	VL
66.4 to 68.4	BV1	pine	VL
68.4 to 69.0	BV1 (narrow)/PR4	pine/spruce-fir	L
69.0 to 69.4	BV1 (narrow)/VD1	pine/spruce-fir	VL/L
69.4 to 70.1	VD2	pine	VL
70.1 to 71.2	PR6 (narrow)/VD2	pine	VL
Whitehorn			
73.4 to 73.6	BV1	pine	VL
73.6 to 74.0	BV1 (narrow)/BK4	pine/pine, spruce, wetlands	L
74.0 to 74.6	BK4	pine, spruce, wetlands	M
74.6 to 75.5	BV1	pine	VL

1 The use of the term "narrow signifies that the unit forms a thin strip adjacent to the existing highway and another ecosite.

2 VL: very low; L: low; M: moderate; H: high

This area is small and may be a product of previous construction activity.

There are several general approaches which can be taken to reduce the impact of highway construction. The following are most applicable to this project:

- Borrow pit locations, construction camps and storage sites can be located within dry pine forest or areas of existing disturbance.

- Appropriate and cautiously controlled construction techniques in wetland areas would reduce disruption of drainage patterns (Rothwell 1978, Kondla 1977, Jeglum 1975, Meeuwig and Packer, 1976).

- Development of "lure" areas for ungulates and use of less palatable plant species for reclamation would encourage establishment of vegetation.

- Use of native species or less aggressive non-native species would reduce the impact of non-native vegetation on surrounding native vegetation.

- Proper removal and re-use of topsoils would aid in vegetation re-establishment, both by providing a suitable medium for seed establishment and by supplying a source of native seed.

- Training of contractors and operators in vegetation and soil materials handling and the significance of various vegetation types would reduce the potential for "unplanned" impacts.

5.4.3 ADDITIONAL WORK

Further field work will be performed to ascertain the actual extent of populations of significant plant species in sites identified as having moderate or high potential impacts. Appropriate mitigative measures will be established to conserve these species.

Mitigative measures for sites having low potential impact need to be identified and detailed to ensure that impacts on these habitats are minimized.

Any significant changes in alignment as a result of detailed design will require additional vegetation analysis.

5.4.4 SUMMARY

The overall impact of the proposed improvements on the significant vegetation resources of the Bow River valley in Banff National Park will be low due to the preponderance of dry lodgepole pine vegetation.

Specific impacts on the more significant spruce and wetland vegetation can be reduced through mitigation such as carefully controlled construction transplanting and re-creation of similar habitat, and minor changes in alignment to avoid the most important sites.

General impacts on vegetation can be reduced principally through appropriate location of construction-related activities, sound reclamation practices and attention to maintaining drainage patterns.

Further studies are required to establish the populations of significant plant species and to detail the mitigation approaches which need to be taken.

SECTION 5.5

FISH RESOURCE

5.5.1 POTENTIAL IMPACTS

Highway construction impacts on the fish resource normally result from the following activities:

- Sediment entering streams where it may settle on the substrate thus reducing habitat for benthic invertebrates and aquatic plants. Siltation also reduces gravel porosity affecting the suitability of the habitat for spawning and also for juvenile rearing;

- Creation of barriers to upstream migration alienating stream reaches upstream of the barrier;

- Habitat alteration may occur at the highway crossing by works installed for the crossing. Bridges or culverts, and right-of-way clearing can alter existing habitat. Habitat alteration will also occur as the result of the introduction of stabilizing material to armour the streambank or streambed and by the incidental introduction of trees or other large organic debris during preconstruction or construction activities;

- Fish eggs or free swimming fish, and other stream biota may be destroyed during instream work;

- Water use may reduce stream flows or remove fish from the stream; and

- Water quality may be affected by a wide range of chemicals and physical changes resulting from construction and operation of the highway. Potential physical changes include temperature and hydraulic changes due to more rapid road runoff, alteration of seepages or small channel inflows important in maintaining wetland fish populations, and icing under bridges or in culverts. Chemical changes may occur due to introduction of hydrocarbons, de-icing chemicals and spills or incidental loss or usage of a wide variety of other chemicals.

The new highway alignment currently proposed does not affect the Bow River or side channels except at the crossing at km 69.3, at km 30.0 where it may fill part of a fish bearing wetland, at km 40.8 where a side channel would be at least partially filled, and possibly at km 75.0 where a backwater exists. The proposed highway will cross eight fish bearing tributary streams (Table 3.5-2), excluding the Pipestone River where improvements are already underway. The most significant fish resources in the study area occur in Altrude Creek and in the Bow River. Bridging the Bow River with a structure similar to the existing structure can be expected to have limited impact on aquatic resources. Altrude Creek will require special precautions to avoid significant impacts to fish. This creek is within the Castle Mountain

Interchange. Present plans indicate that it is to be crossed by both eastbound and westbound lanes of the TCH and by eastbound entrance and westbound exit ramps. This combination of crossings is a primary concern for fish passage (Underwood McLellan Ltd., 1985). Other stream crossings or aquatic habitat intersections are of lesser concern but will require preparation of specific mitigative measures.

5.5.2 OPPORTUNITIES FOR MITIGATION

Mitigative measures undertaken in Phases I and II have centred on design criteria to maintain fish passage, minor alignment changes, construction scheduling, and a variety of special measures. The Chinaman Creek diversion was undertaken conforming to recommended mitigative measures and the overall program proved successful. Other mitigative procedures have been less well monitored and so their performance is not easily documented. Unforeseen problems have arisen causing deviation from mitigative scheduling of construction. Efforts will be made to avoid future problems by obtaining necessary approvals well in advance of scheduled construction. Also construction related delays will be given high priority for resolution by the construction manager.

Mitigative measures applied to the previous TCH phases are also applicable to Phase III. These measures are well documented in Section 5.5.6 of the Phase II EIS and are not repeated here. For Phase III construction, maintaining small channel or seepage flows into wetland areas will also be required.

Specific measures to be adopted in fish bearing streams for Phase III are as follows:

Construction Scheduling

On fish bearing streams, construction will be scheduled for July and August when neither spring nor fall spawning is taking place. If further surveys indicate an absence of spring spawning fish (cutthroat trout, rainbow trout), construction may commence after the hatching of fall deposited eggs, usually close to ice break-up.

Vegetation Clearing

Vegetative cover will be left along fish-bearing streams in the vicinity of the highway project wherever possible.

Watercourse Crossings

In streams crossed by the highway which are utilized by fish, culverts and bridges will be designed to allow fish passage at all times of the year.

Bridges or open-bottom culverts are desirable to preserve the streambed and are preferred to conventional culverts. However, where open-bottom culverts are not practicable, the conventional culvert may be installed so that the bottom of the structure is at least 0.3 m below the natural grade of the stream. This requires that an oversized culvert be installed so that there is sufficient depth available to allow streambed material to cover the invert of the culvert.

To ensure fish passage, culverts (open-bottom and conventional) generally should not exceed 35 m in length since fish tend not to enter longer culverts. Maximum acceptable water velocities are governed by the distance that fish can swim continuously without stopping to rest. As the length of culvert increases, the maximum acceptable velocity rapidly decreases.

The swimming speed of fish depends greatly on their length, with the larger fish able to maintain higher speeds over a longer period before becoming fatigued. Most fish caught in the area were less than 30 cm in length. As a design guideline, velocities in culverts should not exceed 0.7m/s for periods of more than three consecutive days during the average annual flood period.

To maintain fish passage under low flow conditions it is desirable to maintain a minimum water depth of 100 mm in the culvert barrel by providing tailwater control. Where multiple culverts are to be installed at a crossing, one culvert should be installed at least 0.3 m lower than the other culverts so that all discharge passes through one culvert during low flow.

Bridges or open-bottom culverts will be considered on larger streams such as Taylor Creek. The Bow River is to be crossed using a bridge. Bridges are in place at existing crossings of Redearth Creek, Moraine Creek and Altrude Creek. New construction at Redearth and Moraine creeks will also use bridges. Altrude Creek is a special case and requires a detailed engineering and fisheries study to evaluate possible designs before the interchange is finalized. Altrude Creek is of particular concern because of the close proximity of the Castle Mountain Interchange. In this case the stream may be diverted either to the west so that the crossed sections of the stream may be separated or to the east where the crossing is reduced to an acceptable length. All other streams will be retained in their natural channel above and below the highway crossing.

Highway Drainage

Drainage for the highway will be designed to direct water from asphalt pavement and the centre median to well vegetated areas, a minimum 60 m in length, before entering surface waters. Where this is not practicable, settling basins will be constructed.

Flows to wetlands will be maintained and not diverted significantly from their present point of entry to wetlands.

Pre-Construction Protection

Buffers of uncut vegetation 5 to 10 m in width will be left bordering creeks until immediately prior to construction.

Vegetation cut for survey lines and the highway right-of-way will be piled away from aquatic systems.

No vehicle fording of streams will be permitted.

Sediment Control

Erosion of disturbed soils and siltation of streams with consequent sedimentation of aquatic habitats will be controlled in the following ways:

- Disturbed soils and erosive cut slopes will be revegetated as soon as practicable after construction.
- In areas where runoff could carry silt into streams, physical erosion control techniques such as protection of soils with coarse granular materials, berms, sand bagging and runoff diversion ditching will be developed as necessary.
- Water pumped from any excavations will be discharged onto vegetated land away from waterbodies to control sediment input to streams.
- In-stream work will be carried out as is practicable in the dry by diverting flows away from construction in larger streams, or diverting the entire flow through piping in smaller streams. Timing of this construction will be scheduled to avoid fish migration and spawning or egg incubation periods. Such work will be carried out in as short a time as possible and any activities which may cause heavy sedimentation or fish population disruption will be closely monitored.

Water Removal

Water truck filling for dust control will utilize watercourses not containing fish. Alternatively the guidelines for intake screens and intake velocities will be applied (Fisheries and Marine Service, 1972). Locations of likely fish spawning or overwintering will be avoided. Also, where water is drawn from fish bearing streams, withdrawal will not exceed 10 percent of the stream flow. Where water is drawn from lakes or ponds, withdrawal will not exceed 0.3 m or 10 percent of water depth, whichever is less.

Gravel Removal

Gravel will not be taken from any watercourses.

Potential Contaminants

Solid waste material will not be discarded in watercourses.

Machinery and equipment will not be washed or cleaned in areas where wastewater might enter nearby streams.

Liquids which might cause contamination will be handled and stored in a manner that will prevent their spilling into the streams along the project route. In particular, fuel will not be stored within 800 m of streams. Spent materials will be disposed of by incineration, recycling or hauled to existing waste disposal facilities.

No herbicides or insecticides will be used near waterbodies.

Migration Barriers

Culverts, dams and dykes used to temporarily or permanently control stream flow will be placed in such a fashion as to cause minimum sedimentation in the waterbody, and disturbance to fish resources.

Any obstruction of waterways caused by project activity will be removed immediately.

In addition to the above mitigative measures, an opportunity exists to mitigate the impact of some of the existing works installed in water courses. Some culverts exist along the present highway that are complete or partial barriers to fish. In such cases new culverts or tailwater control could be established that would mitigate these situations. It was also noted in Sections 5.2 and 5.9 that encroachment on two areas of the Bow River (km 51.5 and km 55.5) may be desirable alternatives to otherwise extensive terrain disturbance. Such encroachment would allow the opportunity to enhance these previously altered stream sections for fish.

5.5.3 ADDITIONAL WORK

Further field investigation of fish bearing streams are needed to determine seasonal fish habitat utilization in the crossing areas. Such information is necessary to establish appropriate construction timing for each creek.

The relationship of the new Castle Mountain Interchange to Altrude Creek will be considered from both the engineering and biological point of view, and an optimal design will be developed. Movement of the creek to the east or west will be considered along with alternative crossing designs.

If the project results in further encroachment of the Bow River at km 51.5 and 55.5 then a detailed survey of the existing habitat should be carried out to facilitate enhancement design. Similarly further consideration should be given to the two backwater areas at km 30.0 and 40.8, if they are to be impacted by highway fill.

5.5.4 SUMMARY

Impacts on aquatic resources as a result of highway construction are expected to be low if the mitigation techniques described above are applied.

There appear to be no non-mitigatable impacts on any fish bearing streams. The most significant fish resources in the study area are found in the Bow River and in Altrude Creek. Alternative designs for the multiple Altrude Creek crossing will be explored to minimize impacts on the resource. Care will also be exercised during the construction of the Bow River bridge to prevent contaminants or excessive amounts of silt from reaching the river.

SECTION 5.6

IMPACTS ON WILDLIFE RESOURCES

Potential impacts on wildlife of the proposed twinning of the TCH from the Sunshine Interchange (km 26) to the Icefields Parkway (km 75) include direct mortality from collisions with vehicles, habitat alteration or loss, disturbance and disruption of movements.

5.6.1 POTENTIAL IMPACTS ON MAMMALS

Direct Mortality

The impact of the proposed highway improvements on the number of wildlife/vehicle collisions is difficult to predict because of the multitude of factors involved and a lack of information on similar developments in the scientific literature. If traffic volumes and vehicular speeds increase as a result of the highway improvements, then the frequency of road kills could be expected to increase (Grenier 1973, Reilly and Green 1974, Goodwin and Ward 1976, Arnold 1977). However, whether there is in fact an increase or decrease will also depend on the final alignment, highway cross section and mitigative measures.

The present ungulate collision mortality from throughout the study area is very low compared to the section of highway from East Gate to Sunshine Road (Table 5.6-1). The low mortality of the east half of the area from Sunshine Road to Castle Mountain Junction reflects the location of the alignment south of the major ungulate winter ranges (Figure 3.6-1). The very low mortality from west of Castle Mountain Junction reflects the limited number of wintering ungulates along the highway. The latter section of the Bow Valley is dominated by dense coniferous forests, has more severe winter conditions, and is more constricted than the lower Bow Valley which supports the majority of the wintering ungulate herds (Harrison et al. 1982, Banff Warden Service files).

The section of highway between the East Gate and Sunshine Road had 2.0-3.9 times the number of elk road kills and 2.2-4.3 times the number of mule deer kills per kilometre for the period 1979 to 1981 than the section between Sunshine Road and Castle Mountain Junction (Table 5.6-1). This difference is even more pronounced for the section between Castle Mountain Junction and the Icefields Parkway.

Ungulate collision mortality in the study area is expected to be greatest during seasonal migrations and during the rut. Although major elk winter ranges are located largely north of the highway many animals move across the highway during spring and fall (Logan and Weir 1985). During spring, elk move west along the Bow Valley and up side drainages which are located primarily on the south side of the Bow Valley (Figure 3.6-1). During fall, elk move back into the Bow Valley from higher elevations and return to the main winter ranges north of the highway. During September and October, elk are engaged in rutting activity which is especially common in the Hillsdale Meadow, Hillsdale Split and Redearth fan area immediately north of the highway between km 34 and 39 (S. Logan, pers. comm.). During the rut, elk are extremely mobile within selected areas and may potentially cross the highway many times during this period. Flygare (1979) clearly demonstrated that ungulate collision mortality increases dramatically in the Park during October and November. In addition, Logan and Weir (1985) reported that 37 percent of elk kills and 35 percent of mule and white-tailed deer kills between Sunshine Road and Castle Mountain Junction occurred during these months.

The proposed alignment of the new lanes of the highway will closely follow the existing lanes particularly east of Castle Mountain Junction. Hence, the new alignment will continue to bypass the main ungulate winter ranges located on the north side of the river. If the proposed alternate alignment for the new lanes south of the existing lanes from km 28.5 to km 33 is selected, then the potential for increased road kills would be further reduced because the new alignment would be located even farther from important winter ranges. Conversely, between km 34 and km 37.5 an alignment of the new lanes north of the existing alignment may increase the risk of collision mortality because it traverses a series of old borrow pits which are used extensively by elk.

An important factor influencing the number of road kills is the width and characteristics of the median separating the east and west bound lanes. Mortality may increase along those portions of the highway that are separated by narrow, un-treed medians or raised concrete barriers. The impacts will be greatest where narrow medians coincide with major ungulate crossing areas. Because of the close proximity of east and west bound traffic along sections of highway with narrow medians, ungulates may panic and some may run along the raised barrier, thus increasing the likelihood of a collision. Conversely, collision mortality may remain at current low levels or even decrease along sections of highway having wide medians with forest cover. Such medians would provide some security for the animals before the next lane of traffic is crossed. In addition, the risk of road kills may be reduced because:

- traffic is separated into unidirectional components;
- motorists have more opportunity for evasive action on a twinned highway; and,
- drivers are shielded from oncoming headlights, thus increasing the detection of animals.

During periodic observations of mule and white-tailed deer crossing the existing highway, it is apparent that they are aware of oncoming traffic in one direction and often become fixated to it and are thus vulnerable to vehicles travelling in the opposite direction. Deer have also been observed to retreat from oncoming traffic to the forest edge and successfully cross after the traffic has passed (R.D. Jakimchuk, pers. notes). The foregoing behaviors would reduce collision vulnerability along a wide median divided sec-

tion of highway where the traffic stream is separated, unidirectional and where retreat cover is present.

Between Sunshine Road and Castle Mountain Interchange, a total of 21 km, 15 km will consist of a narrow or concrete median (Table 2.2-1). The impact of this section of highway would be reduced if the proposed south alternative alignment is selected since this would reduce the extent of narrow median by 4 km. In general, road mortality is expected to be reduced if the length of wide median is maximized. From Castle Mountain Junction to the Icefields Parkway, the use of wide median will be greater (13 km over 23 km of highway). Therefore, the incidence of road kills along this section of road is expected to be minimized because of the low density of winter ungulates and the favourable highway design.

The present level of elk collision mortality along the highway between Sunshine Road and the Icefields Parkway is low, compared to the total population of elk in the Bow Valley. From 1981 to 1984, annual collision mortality of elk for this section constituted 1.5 to 1.9 percent of the population, assuming a minimum population size of about 800 animals in the entire Bow Valley (R. Kunelius, pers. comm.). Similar low collision mortality as a percentage of total population size along this section of highway is probable for mule deer, although quantitative estimates of deer population sizes for the Bow Valley are not available.

The effect of the proposed improvements on the mortality of white-tailed deer is expected to be minimal, since very few animals have been killed along this section of highway (Section 3.6-1).

TABLE 5.6-1: COMPARISON OF UNGULATE MORTALITY FOR 1977-84 IN TCH SECTIONS: km 0-km 25, km 25-km 47, km 47-km 75

AREA	ELK								MULE DEER							
	1977	1978	1979	1980	1981	1982	1983	1984	1977	1978	1979	1980	1981	1982	1983	1984
EAST GATE TO SUNSHINE ROAD (km 0-26)[1]																
No. OF KILLS	-	-	48	37	40	-	-	-	-	-	25	29	15	-	-	-
KILLS/km	-	-	1.85	1.42	1.54	-	-	-	-	-	0.96	0.73	0.58	-	-	-
SUNSHINE ROAD TO CASTLE MTN. JCT. (km 25-47)[2]																
NUMBER OF KILLS	16	12	11	16	9	12	14	9	14	8	8	4	6	4	2	0
KILLS/km	0.70	0.52	0.48	0.70	0.39	0.52	0.61	0.39	0.61	0.35	0.35	0.17	0.26	0.17	0.09	0
CASTLE MTN JCT. TO ICEFIELDS PARKWAY (km 47-76)[3]																
Number of Kills	-	-	-	-	3	2	0	6	-	-	-	-	3	4	4	3
KILLS/km	-	-	-	-	0.11	0.07	0.0	0.22	-	-	-	-	0.11	0.05	0.15	0.11
DIFFERENCE (KILLS/km)																
km 0-26 vs km 25-47	-	-	3.9x	2.0x	3.9x	-	-	-	-	-	2.7x	4.3x	2.2x	-	-	-
km 0-26 vs km 47-75	-	-	-	-	14.0x	-	-	-	-	-	-	-	5.3x	-	-	-
km 25-48 vs km 47-75	-	-	-	-	3.5x	7.4x	14.0x	1.8x	-	-	-	-	2.4x	1.1x	0.6x	0.1x

1 from Harrison et al. (1982), 2 from Logan and Weir (1985). 3 from Banff Warden Service Files.

The impact of the proposed improvements on moose may be significant because of the small number of moose in the Park. From 1981 to 1984, eight road kills of moose were reported between Sunshine Road and the Icefields Parkway. Since the population of moose in the Bow Valley is very low (Holroyd 1979), any increase in unnatural mortality as a result of highway twinning may result in a population decline.

Since the fencing and underpasses employed along the highway from East Gate to Sunshine Road are expected to reduce ungulate mortalities to negligible levels, any potential increase in collision mortality as a result of twinning west of Sunshine Road will likely not have a significant impact on population levels of elk and deer in the Bow Valley. Railroad collision mortality will be the major source of unnatural mortality in the park after fencing and underpasses are fully operational east of the Sunshine Road. From 1970-1984, railroad mortality constituted 35 percent of all collision mortality in the Park (Banff Warden Services files).

Direct mortality of other large mammals such as grizzly bears, black bears, wolves, lynx and wolverine may increase as a result of highway twinning. The impact could be significant for such species as grizzly bears because even a small number of road kills could affect local populations. However, the number of road kills of grizzly and black bears have declined since 1980 possibly because of improved garbage disposal in the park. No road kills of cougar have been reported west of Sunshine Road.

Direct mortality as a result of collisions with vehicles would likely increase for small mammals such as rodents, shrews and ground squirrels, especially where the new lane intersects their former home ranges. However, due to the large numbers of small mammals within the park and their high productivity, their populations can withstand vehicle-related mortality. The impact on more mobile small mammals such as terrestrial furbearers is not expected to be significant.

Habitat Loss

Loss and alteration of mammal habitats would occur during construction of the highway right-of-way, at interchange sites and at borrow pits. Construction of the new lanes will alter or destroy habitat within a narrow corridor. If total fencing similar to Phase I and II is used on both sides of the highway, habitat losses would be two to four times greater than that which would occur from the new lanes alone. The new lanes will traverse 11.4 km of high quality elk winter range, 18.7 km of moose winter range, and 3.8 km of deer winter range (Table 3.6-3).

The construction of new borrow pits and the expansion of existing pits will add to the habitat losses of ungulates. However, the amount of habitat affected cannot be calculated because the number of borrow pits required for construction has not been finalized.

The new Castle Mountain Junction Interchange will impinge upon high quality year-round habitat for elk and moose, and summer habitat for deer (Holroyd and Van Tighem 1983). Elk

have been observed using the wet depressions immediately northwest of the interchange (B. Leeson, pers. comm.).

In summary, the amount of habitat lost by construction of the new lanes is likely to be insignificant given the large area of prime winter range for ungulates located on the north side of the Bow Valley. However, fencing of the highway combined with the requirement for new borrow areas could increase habitat losses significantly. The incremental impact of this habitat loss on ungulates could become significant if populations increase in the Bow Valley in the future.

The impact of habitat alteration on mammals other than ungulates will be minimal. The paved highway will result in direct loss of small mammal habitat, but these species would colonize revegetated portions of the right-of-way.

Disturbance of Mammals

Disturbance to mammals will be greatest during the construction phase of the project as a result of blasting, movements of large machinery and the presence of construction workers. Disturbance during construction or operation of the highway is not expected to have significant impacts on ungulate because most animals in the park are habituated to loud noises, vehicles and the presence of humans. Local displacement of ungulates may occur where construction activity is intense or in cases where animals are directly harassed. This displacement would be temporary with animals likely returning soon after construction activity is reduced.

A prolonged avoidance of an area by ungulates as a result of disturbance can result in both an effective loss of habitat adjacent to the corridor and a restriction of movement to those parts of the range that are not cut off by the corridor. If animals are forced into marginal areas, or if they are concentrated in portions of prime habitat the carrying capacity of the range may be reduced. Alarm reactions that are induced by corridor-related human activity may also alter activity budgets of ungulates, and may possibly reduce the amount of energy available for growth, survival and reproduction.

Schultz and Bailey (1978) found that unhunted elk in Rocky Mountain National Park, Colorado were very tolerant of traffic and human activity in the Park. Even intentional harrassment of elk by the researchers did not produce significant change in numbers of elk seen in their study area one week after the disturbance. Similar behaviour has been observed for elk along Phase I and II of the highway in Banff National Park (Banff Warden Service, pers. comm.). Hence, elk are not expected to be affected by the highway improvements.

The effects of disturbance on mule and white-tailed deer are expected to be minimal. In Colorado, Ward et al. (1980) showed that mule deer were not as easily disturbed as elk and that unhunted populations were more tolerant of disturbance than hunted populations. In Minnesota, Dorrance et al. (1975) reported that an unhunted white-tailed deer population was not affected by disturbance from snowmobiles. Although deer were temporarily displaced from areas immediately adjacent to snowmobile trails, the deer rapidly returned to trail areas after periods of heavy snowmobile traffic.

The impacts of disturbance on mammals other than ungulates are expected to be minor. Black bears are habituated to human activity while grizzly bears are wide ranging and normally spend little time adjacent to the highway. Similarly, wolves, cougar and lynx have large home ranges and spend relatively little time along the highway.

Disruption of Movements

A two-lane divided highway and the associated increase in vehicular traffic may impede the free passage of wildlife between ranges on either side of the corridor (Reilly and Green 1974, Ward et al. 1976). Much of the existing movement across the highway along Phase III consists of ungulates moving between summer and winter ranges during the spring and fall. A disruption in movements could delay these migrations or result in the uneven utilization of existing ranges.

The disruption of wildlife movements is not expected to increase significantly above existing levels, except along sections of the highway having a raised concrete barrier. Movements of wildlife would also be impeded if the highway were fenced, although appropriate underpasses mitigate this impact. Preliminary results from monitoring of Phase I mitigative measures show that many wildlife species are making high use of the underpasses provided. Since the proposed extent of concrete barrier east of Castle Mountain Interchange is very limited (Table 2.2-1), disruption of wildlife movements are not expected to be serious.

The highway improvements may create a physical barrier to the movements of small mammals. However, this impact is expected to be localized and would not affect populations in the Bow Valley.

5.6.2 POTENTIAL IMPACTS ON BIRDS

The experience from Phase II indicates that the impacts of disturbance on birds, especially nesting raptors, will be minor. This is because birds occupying habitat adjacent to the corridor are already habituated to noise and vehicular traffic. The highway development is not expected to affect the two nesting pairs of Osprey in Phase III. These nests are located at least 400 m from the highway alignment (Figure 3.6-3).

Collision mortality of birds along Phase III may increase. Impacts would be greatest on those species that gather in large flocks on or adjacent to the paved surface such as grey-crowned rosy finches, pine siskins and evening grosbeaks. However, to date, the problem has not been significant in Phases I and II (M.McIvor, pers. comm.).

Habitat loss may have a greater impact on birds as a result of the highway improvements. Small but valuable wetland complexes within the Vermilion Lakes Biological Units may be affected by highway construction and borrow pit development. These wetland areas support a high density and diversity of breeding birds, including waterfowl, shorebirds, raptors and passerines. The areas of greatest conflict occur along the northern edge of the highway alignment at km 31.2 and between km 39-40. Wetland areas would be destroyed or reduced in size if water is drained or if depressions are filled in as a result of construction activities.

Beneficial impacts could occur if borrow pits were excavated below the groundwater table resulting in the creation of new wetland habitats.

5.6.3 POTENTIAL IMPACTS ON AMPHIBIANS AND REPTILES

The impacts of highway improvements on the herptile fauna are expected to be insignificant. Some habitat loss will occur if wetlands within the Bow River Floodplain are drained or filled as a result of construction or borrow pit development. Again, some new habitat may be created if borrow pits are flooded or if water is impounded adjacent to the highway. A limited number of animals may be killed by vehicles along the highway.

5.6.4 OPPORTUNITIES FOR MITIGATION

Notwithstanding the selection of appropriate alignment with respect to winter range and the use of wide medians, one of the major environmental concerns of the proposed improvements will still be collision mortality on ungulates. In Phase I and II this concern led to the development of a comprehensive mitigative program consisting of wildlife underpasses and fencing. The magnitude of the mortality problem for Phase III is not as great as in previous phases, and new approaches to mitigation to deal with specific problem areas may be required.

Mitigation of impacts for other species are similar to those developed in previous phases and are discussed below.

Effectiveness of Phase I and II Measures

Although results to date from the Phase I fencing/underpass program are preliminary and inconclusive, several early questions have been clarified. Monitoring studies are underway and there is a need to continue these to document the relative crossing success of the two underpass types, large diameter culverts and the open span bridge underpass. Both types have been used by significant numbers of mule deer and elk. In addition, tracks of other species (coyote, wolf, black bear and lynx) were documented using the Morrison Coulee culvert underpass (Browne and Wackerle 1985). Although large numbers of deer and elk have passed through both underpass types, not all entries resulted in complete passage. There is evidence that some incomplete passages resulted from animals entering to feed in the fenced median then returning. It is presently unknown if hesitation occurs at some distance from the underpass entrance. These questions require further study before relative success rates

can be established.

The recent completion of fencing to km 11.4 in January 1985 will provide data on more heavily used crossing areas and will enable a more reliable evaluation of changes in the rate of road mortality.

Mitigation of construction-related disturbance in Phase II involved measures to habituate nesting raptors (bald eagle) to simulated blasting noise by exposing them to cracker shell explosions. In addition, bighorn sheep were herded away from the site of extensive blasting around km 18-19. Both the bald eagle and osprey nests at Vermilion Lakes were occupied in the spring of 1985. There is no evidence that these birds have been adversely affected by construction activities to date (A. Anderson, pers. comm.).

The strong habitat associations of sheep were such that the sheep were not displaced by disturbance. In fact, they continued to use altered habitat despite its progressive removal by large equipment and the presence of construction crews. This use continued despite loud noise, intensive activity and heavy dust from operations. The major problem associated with sheep was to herd them from the area to avoid mortality during blasting (P. Jacobson, pers. comm.).

Phase III Mitigation

As discussed in Section 5.6.1, ungulate mortality rates in the Upper Bow Valley are considerably lower than those along ranges in the lower parts of the valley. The routing of the present highway and the new lanes generally follow the south side of the valley (north facing slopes) and are in close proximity to the Bow River itself. As a result, the new highway will not directly intersect heavily used winter ranges to the degree experienced in Phases I and II (Figure 3.6-1).

For Phase III, a "phased" approach to mitigation can be justified by the following reasons:

1) The cost and aesthetic consequences of the Phase I and Phase II fencing/underpass program have been significant. A phased approach would permit less expensive alternatives to total fencing to be tested.

2) The significantly lower mortality rates along the Phase III section of highway, and the fact that very limited information is available on the impact of highway twinning on ungulate mortality rates. It is not known if mortality rates will increase, stay the same or decrease. The wide median configuration may be an effective mitigative measure in this regard as it separates traffic streams into "one-way" components. Also, the selection of the most southerly highway alignment alternatives would avoid winter ranges along the Bow River and may reduce ungulate mortality.

3) A phased approach will address problems as they are identified using the existing known and effective technology for mitigation where necessary. Such an approach, however, might preclude certain retroactive actions which are dependent on initial highway design. For example, the retroactive installation of underpasses could be limited to culvert-type structures.

Mitigation Process

Prior to construction, the phased approach would comprise:

- Identifying viable locations for the alignment of the new lanes, and preparing a preliminary design for each location.

- Selection of a preferred alignment using available information on ungulate distributions, significant mortality areas, and habitat quality together with information on other pertinent environmental concerns (e.g. disturbance of terrain).

- Analysis of existing wildlife data for km 26-46 leading to location and design of mitigation compatible with the preferred alignment of the new lanes and the mode of separation from the existing lanes; the results would be incorporated in the detailed design and contract documents covering this section.

- Since the section west of Castle Mountain Junction (km 48-69) is to be constructed last (Figure 2.3-1), research and analysis for this area could continue and adjustments could be made to both alignment and design of mitigation measures should new information become available.

Following construction the phased approach would comprise:

- Monitoring mortality rates and comparing rates associated with different highway modes: wide separation medians, narrow medians and concrete barriers. Monitoring should be systematic and quantitative to ensure development of a statistically reliable and valid data base.

- Experimental deployment and monitoring of driver-warning signs that flash whenever ungulates approach the highway.

- Based on the monitoring program the effectiveness of the mitigation measures would be assessed and where necessary, changes or additional measures would be undertaken.

The phased approach to Phase III will permit a limited fencing program to be considered. The principle of limited fencing is not to physically exclude animals from the entire right-of-way but to encourage underpass use at their already preferred crossing location. There is some evidence of "passive" use (that is, use of underpasses at favored crossing locations before fencing is tied in). Both mule deer and elk used underpasses at the East Gate and Morrison Coulee to a minor degree before fencing was complete (Browne and Wackerle 1985). In Utah, passive use by mule deer of an overpass was common before fencing was erected. Experience to date in Phase I has shown use of existing structures and apparent acceptance by elk and deer to those structures and one-way gates.

Although animals can circumvent a limited length of fence, the concept is dependent on a combination of locating the underpass at a preferred crossing site and rendering the right-of-way within the fence unattractive to ungulates. The locations of preferred crossing sites are presently being identified by the Banff Warden Service through field studies of trail patterns and analysis of road kill distribution. The latter requirement may be accomplished by placement of sterile or unpalatable material (gravel shoulders, bark mulch) along the road shoulder and median within the fenced zone. Experience in Phase I shows that elk are attracted to the lush growth of ungrazed grasses within the fenced right-of-way. This design could be used in conjunction with baiting to encourage passive ungulate use. There would be some future flexibility to extend the fence on either side of the underpass as necessary to direct movements.

Localized fencing can also be used to divert movements of wildlife from hazardous areas (e.g. Type C and D cross sections).

It is anticipated that the foregoing measures will provide adequate control of ungulate mortality. Although limited fencing is experimental and is subject to problems such as animals circumventing the fence, it does provide flexibility in dealing with mortality problems. Its main advantage is that it does not entail a commitment to a costly and aesthetically unattractive program to deal with a limited road mortality problem. Various alternatives for local fencing and underpass locations will be examined during project design.

Other Measures

a)Mitigation of Loss of Wildlife Habitat

Limited fencing reduces the amount of habitat excluded from use by ungulates. A total fencing program adds to habitat loss and this is exacerbated by the aesthetic requirements for fencing setbacks.

Mitigation of habitat loss would also result from:

- Maximizing use of existing borrow pit sites to supply materials for highway construction so as to minimize habitat loss or alteration.

- Rehabilitation and revegetation of existing and new borrow pits, as required, to provide forage for ungulates.

- Reclamation and re-contouring of borrow pits excavated below groundwater to develop aquatic habitat for waterfowl, amphibians and aquatic furbearers.

- Habitat improvement and enhancement within the Bow Valley. This may include controlled burning to create grassland in forested areas and fertilization of existing ranges to increase their productivity.

- Avoidance of existing wetland complexes along the Bow River.

b) Mitigation of Disturbance

- Maintaining a forest screen between highway and elk rutting areas, waterfowl breeding areas, and raptor nest sites.

- No other special measures required, based on past experience along Phases I and II.

5.6.5 ADDITIONAL WORK

The following analyses and studies will be carried out in cooperation with Parks Canada:.

- Continued mortality monitoring along Phase III and analysis of road kill distribution and site characteristics.

- Delineation of seasonal movement patterns of elk on Phase III.

- Experimental study of culvert and bridge-type underpasses to evaluate passage success and the relative acceptability to ungulates of the two modes of structure.

- Preliminary design and site analysis for fencing and underpass alternatives on Phase III. This analysis would be used to identify the appropriate crossing structure for each site.

- Surveys of waterfowl, raptors and aquatic furbearers to fill data gaps, especially in areas that will be encroached upon by the highway.

- Selective Monitoring programs following construction, including studies of:

  i) mortality rates and locations - wide vs narrow median;

  ii) effectiveness of limited fencing and passive underpass use;

  iii) effectiveness of ungulate-activated warning signal.

5.6.6 SUMMARY

The level of ungulate road collision mortality in the project area for Phase III is considerably less than that encountered to the east (Phases I and II). This is primarily due to the alignment of the existing highway through the area which avoids the known winter range west of Sunshine Road. Elk sustain the highest mortality rate of ungulates followed by mule deer and moose. However, because of the small number of moose in the Park, they may be exposed to the greatest impact.

It is not known, neither can it be reliably predicted, if the road mortality rate will increase or decrease as a result of the proposed improvements to the TCH. The proposed use of a wide forested median, wherever possible, is expected to minimize the road kill problem. Nevertheless it must be expected that a prime concern for Phase III will be a perceived increase in road mortality. Fencing and underpasses are known to be effective in mitigating this type of mortality. The characteristics of Phase III, however, do not warrant implementation of the same program used in Phases I and II. A phased program of mitigation that involves consideration of limited fencing is proposed. Additional data are required from Phases I and II to define the most acceptable underpass type. To ensure effectiveness, this approach will also require a monitoring study of ungulate mortality rates on Phase III.

For the purposes of this initial assessment, it can be concluded that with adequate design, mitigation and monitoring the impact of road mortality in Phase III can be kept to an acceptable level.

Other adverse impacts associated with Phase III include habitat loss for birds and mammals, disturbance and disruption of movements. These impacts are considered to be minor and can be offset by the mitigative measures proposed.

SECTION 5.7

LAND USE AND RECREATION

5.7.1 Potential Impacts

All The existing recreational sites adjacent to the highway may be affected by the proposed twinning in that the present design philosophy for the four laning, calls for the retention of vegetated medians whenever possible. In so doing, the potential exists for reduction or elimination of the current easy east/west access into these facilities. Other impacts will range from total removal and/or relocation of these facilities, to reductions in the present capacities of these sites.

5.7.2 OPPORTUNITIES FOR MITIGATION

The sites and facilities along the existing TCH have been reviewed by Parks Canada (Parks Canada, 1985). Their future treatment and requirements for access from the improved highway are summarized in Table 5.7-1.

Similar recreation sites in Phases I and II have been effectively serviced using paved, at grade, crossovers either aligned with the facility as at Carrot Creek Pit, or in close proximity as at Valleyview Picnic Site. This method is the easiest and most cost effective means of maintaining two-way access to such facilities. Signs would be required to direct travellers to the access to these areas. The general concept of providing access to these facilities from the secondary route does not present a feasible alternative as several pedestrian crossings of the Bow River and TCH would be required.

In addition to the treatment of at the sites covered by Table 5.7-1 access to the Bow River to facilitate use of the river by canoeists and kayakers will be provided at the following locations:

- for west bound traffic, below the Lake Louise rapids, above and below the Redearth rapids

- for east bound traffic, above the Lake Louise rapids

5.7.3 Summary

Parks Canada have reviewed the use and importance of the various recreation sites along the highway. As a result, access to all four trailheads will be maintained; the Castle Mountain viewpoint will be relocated and provided with two-way access; three picnic sites east of Castle Mountain Junction will be eliminated; and the Lake Louise overflow campground will be closed. Access to the Bow River for canoeists and kayakers will be provided at various points.

TABLE 5.7-1: FUTURE TREATMENT OF RECREATIONAL SITES AND FACILITIES, km 27.0 - 75.0

SITE AND LOCATION	REQUIREMENTS
PICNIC SITES	
Wolverine Ck. (km 29.6)	Eliminate and rehabilitate.
Redearth Ck. (km 37.6)	Eliminate and rehabilitate.
Copper Ck. (km 44.9)	Eliminate and rehabilitate.
Altrude Ck. (km 46.8)	Eliminate access from TCH; access will be provided from Hwy 93 as per Fig. 2.2-2 sheet 6.
Taylor Ck. (km 55.2)	Will be retained, if possible.
Bow River (km 64.3)	Will be retained as a rest spot, accessible to east and west bound traffic.
TRAILHEADS:	
Bourgeau Lake (km 29.5)	Eliminate and rehabilitate the existing access. A new access will be relocated off the Sunshine Road, and the trail extended to that point. Trailhead facilities (parking, toilets, garbage) will be located at the new trailhead.
Redearth Ck. (km 36.0)	Will be retained and be accessible to east and west bound traffic.
Twin/Smith Lakes (km 46.8)	Refer to Altrude Creek picnic site.
Taylor Lake (km 55.2)	Will be retained and be accessible to east and west bound traffic.
INTERPRETIVE SITES AND VIEWPOINTS:	
Castle Mountain Viewpoint (km 38.1)	Eliminate and rehabilitate, moving boulder and plaque to new proposed viewpoint at km 38.9. This new viewpoint will have the same capacity as the former one, and will be accessible to both east and west bound traffic.
Bow River (km 64.3)	Refer to Bow River Picnic site.
OVER FLOW CAMPGROUNDS:	
Lake Louise (km 66.6)	Eliminate and rehabilitate. Provide replacement overflow area in new location as required.

SECTION 5.8

LAND USE HISTORY AND ARCHAEOLOGY

5.8.1 POTENTIAL IMPACTS

Impacts on historic, archaeological and palaeontological sites are judged to be significant only during the construction phase of the project. In addition to direct impact by the construction works, there is also a danger of unnecessary damage to nearby known and unknown sites. Disturbance or destruction of such sites are important impacts because fundamental information regarding the geological, ancient and recent history of Canada may be permanently lost.

As a general rule, all terraces are considered potential archaeological sites. Most archaeological evidence will be found at shallow depths with common exposure in the veneer of loess which sometimes mantles coarse fluvial materials.

Of the twelve archaeological sites described in Section 3.8 six are in close vicinity of the proposed project and may be impacted. These site locations are shown on Figure 3.8-1.

5.8.2 OPPORTUNITIES FOR MITIGATION

Other than salvaging and removal of artifacts there are no measures which would mitigate the effect of construction on known sites, where that effect is to bury or destroy the site. Thus the focus is upon additional site work by qualified personnel prior to and during construction.

Twelve sites of interest have been identified in that portion of the project area east of Castle Mountain Junction (km 47). Four of these sites would probably be directly impacted by the project, and an additional two would be affected if the south alignment alternative is selected. A program for salvaging and further investigation of these sites is summarized in Table 5.8-1.

All construction personnel from the survey crews to the final clean-up crews will be alerted to known sites so that they will avoid disturbing them. Instructions will also be given to report any unusual signs that may be revealed during the construction activity. Workers will be instructed not to remove artifacts from their original location.

Further work to be carried out prior to and during construction is summarized in the following section. Because archaeological impacts are very localized, this work would be carried out after the limits of the areas to be disturbed have been established.

5.8.3 ADDITIONAL WORK

A professional archaeologist will be retained by the Proponent following a decision to proceed with the project. The archaeologist will carry out the following work:

a) When the alignment is finalized for km 47 to 70 and the limits of disturbance defined in the field, a reconnaissance-level survey will be carried out to locate and describe potential sites and the degree to which they would be affected by construction.

b) Proposed borrow areas will be inspected and assessed.

c) A program for detailed systematic excavation of selected sites to be carried out prior to construction will be compiled, based on item (a) and (b) above and the work covered by Table 5.8-1. The timing of this work will be governed by the construction schedule.

d) Guidelines will be prepared and distributed for use by surveyors, construction supervisors and personnel so that they may be conscious of archaeological sites and concerns.

Similarly, a suitably qualified palaeontologist will be retained on the advice of Parks Canada to conduct a salvage operation at km 43.2 upon the boulders along the river and possibly the boulder in the viewpoint parking lot, with a view to saving their fossil contents. A paleontologist will also undertake the salvage of specimens from any large boulders of fossil-bearing shale that might be uncovered by excavation along the highway, in the immediate vicinity of the viewpoint.

5.8.4 SUMMARY

There are four known archaeological and palaeontological sites that could be affected by the proposed project between km 26 and 47, and an additional two sites if the south alignment alternative is selected. Field surveys of the route west of km 47 to Lake Louise is expected to identify further sites. The extent to which these sites will be affected will not be known until the detailed alignment has been chosen and the limits of the areas to be disturbed have been marked in the field.

Although the abundance of significant sites along the route is low it is expected that some of them may be of high heritage value. Of particular interest is the palaeontological site at km 43.2 which exhibits an excellent diversity and preservation of Triassic fish fossils.

A program designed to adequately investigate and salvage specimens and data from these sites will be pursued. Professional archaeologists and palaeontologists will be retained.

TABLE 5.8-1: SUGGESTED MITIGATION FOR KNOWN SITES (km 26 to 47)

SITE[1]	LOCATION	TYPE[2]	POTENTIAL HERITAGE VALUE	HIGHWAY IMPACT[3]	MITIGATION
EgPw-2	km 27.4	Historic refuse	Low	None	Site recording
EhPw-13	km 31.3	Prehistoric quarry	High	Possible	Surface and subsurface investigation to define boundaries; salvage excavation as required.
EhPw-14	km 38.2	Palaeontological	-	Probable	Salvage fish fossils prior and during construction in vicinity of site.
EhPw-16	km 29.4	Historic tote road bridge	Low	Probable, with south route	Site recording.
EhPw-17	km 29.4	Skeletal remain deer	Low	Probable, with south route	Backhoe testing in general vicinity of alignment; salvage excavation of encountered cultural remains.
EhPw-18	km 32.4	Prehistoric campsite	Moderate	None	None (if site avoided).
EhPw-19	km 35.7	Historic artifact	Low	None	Site recording
EhPw-21	km 33.2	Prehistoric campsite	High	None	None (if site avoided).
EhPw-22	km 37.5	Prehistoric and historic	High	Probable	Surface and subsurface investigation; salvage excavation as required
EhPx-27	km 45.3	Historic artifact	Low	None	Site recording
EhPx-31	km 45.5	Prehistoric	Low-moderate	Probable	Subsurface investigation to define boundaries; salvage excavation as required.
EhPx-32	km 45.8	Historic artifact	Low	None	Site recording and artifact identification.

1 Refer to Figure 3.8-1 for location.

2 Refer to Section 3.8.2 for details.

3 Assuming alignment proposed in Section 2.

SECTION 5.9

VISUAL RESOURCE

This section provides an initial assessment of the known, potential and assumed effects of the proposed project on the visual environment of the Park.

5.9.1 IMPACTS ON VIEWS FROM THE PROPOSED HIGHWAY

The alignment of the proposed highway closely parallels the existing highway, and for the most part the visual experience of the Bow Valley will not change significantly. Views to the southwest of the alpine mountain ranges will still be restricted by topography.

The Park traveller will benefit from the 55 m minimum centreline separation of the east and westbound lanes and a treed median. It is currently proposed that some 19 (out of 44) km of highway be treated in this way. In concept a treed median will make a significant contribution to the visual experience of the traveller. The view of the other lanes and the oncoming traffic will be largely removed, thereby reducing the scale of the highway environment. The result will be a more aesthetic driving experience, further enhanced by the general sense of safety and security, permitting greater enjoyment of the Park environment. Night travel will also become more enjoyable, without the glare of headlights from oncoming traffic. However, in the typical lodgepole pine forest cover west of Castle Mountain Junction, it would be desirable to use a separation greater than 55 m.

The alternative south alignment between km 28.5 and km 33 is upslope from the existing highway (up to 18 m higher) and it would provide more expansive views of the valley. However, this alignment involves a number of major cuts and fills, with potential major visual impacts.

The number of visual contact points with the Bow River will not change.

The widening of the paved surface occurs in the visually-sensitive foreground of highway users, and will impact views from the highway. Also for about 7 km the proposed east and westbound lanes may be separated by a concrete barrier which would also further detract from the views.

In some locations the highway may encroach on the Bow River. Where the river channel is to be altered to accommodate this encroachment, the regraded banks could be left with an unnatural appearance (as presently exists at km 51.5 and km 55.5). There are also one or two backwater areas that could be impacted (Section 5.5.1). These bodies of water contribute to the visual variety of the views from the road by virtue of their contrast with the swiftly-flowing river waters, and the landscape composition they create.

In Phases I and II of the twinning project major cuts oc-

curred in the montane ecozone, which is characterized by large open grassland areas. In this type of landscape, cut slopes can readily blend into the surrounding landscape, and revegetation with grasses and limited plantings is generally sufficient to recreate a natural appearance. However, the characteristic landscape traversed by Phase III is one of continuous, relatively-uniform forest cover of a boreal or subalpine ecozone. To some, these open cut slopes, even when well vegetated with grasses, will be out of character with the surrounding landscape. To others they will be a welcome contrast. The cuts can be reforested so that they will eventually mold into the background. The visual impacts of some of the larger cuts on the existing highway will remain. These include a major cut at km 43.5, and the rock quarry site at km 44.

5.9.2 IMPACTS ON VIEWS OF THE PROPOSED HIGHWAY

The overall potential for visual impacts of the proposed project on the landscapes of the Bow Valley will be greater in Phase III than in the previous phases. As discussed in the previous section, the previous phases primarily traversed the montane ecozone which generally has a higher visual absorption capability because of the open forest cover and numerous large open grassland areas. This permits the highway to blend readily into the landscape without major alteration to the landscape character. This will not be the case in Phase III, which is located in boreal and subalpine ecozones, characterized by very uniform, consistent forest cover. Here the visual absorption capability is low, and a linear alteration can result in a high degree of contrast with the overall visual characteristics of the landscape.

The major cuts on the alternative south alignment between km 28.5 and km 33 would likely have significant impacts on the views from the Bow Valley Parkway, the railroad and possibly Sulphur Mountain.

There are a number of major cuts which are planned where the choice in alignment is one of encroaching on the river or cutting into the slopes (for example, km 44.5). These cuts will have a visual impact on views from the river.

The widening of the highway right-of-way will generally increase the visual impact of the highway when viewed from high up on the valley sides. Wherever the existing right-of-way is widened (that is, in areas where there is not a treed median) the cleared corridor will be visible from a larger area of the valley.

Where a treed median is left, the new alignment will not be so visible (when viewed at a 90 degree angle to the alignment) up to an elevation of about 750 m above the valley floor. Above this elevation, it is a judgement call as to which situation creates the more serious visual impact: a wider existing highway corridor, or a sixth linear unforested strip (in addition to the two existing highways, the railroad, the powerline and the river).

5.9.3 OPPORTUNITIES FOR MITIGATION

In Section 3.11.4 the visual experience of travelling the existing highway notwithstanding its location in the Park was described as uninspiring. This project provides a major opportunity to substantially improve the situation. Most of the measures that can be adopted are site specific and would be best considered during detailed design. A general discussion is provided below:

Alignment

- The overall driving experience could be enhanced by adjusting the alignment to take advantage of potential views of the peaks on the south side of the valley of the Bow River, and generally provide more interest and variety. This could be accomplished by using a wider separation of the highway and a curvilinear alignment where possible. There are several areas of flat terrain with few physical constraints where this could be done, and occasionally where additional views of the Bow River could be obtained.

- It would be preferrable from a visual perspective to minimize cuts. For reasons given earlier, large cuts would constitute a major visual impact on the landscape when viewed from distant points in the Park, even though some highway travellers may find them acceptable. Also minimizing cuts reduces the possibility of erosion and revegetation problems.

- There are a number of existing borrow areas along the length of the project which have reforested naturally to varying degrees; some of them have become desirable wildlife habitat areas. Many of the borrow areas have an unnatural rectangular shape. These areas could be reused, and their visual impact could be mitigated.

Highway Separation

- A 55 m centreline separation of the east and west bound lanes would result in a forest median of 12 m width (Figure 2.2-1, Cross section B). In the lodgepole pine forest cover which prevails west of Castle Mountain Junction, this median will be unattractive and provide minimal screening value. The appropriate mitigation procedure for these conditions is to increase the separation of the lanes and provide edge treatment as discussed below.

Right-of-Way Edge Treatment

- To avoid a uniform corridor effect the cleared edge of the right-of-way should be modulated. This is especially important in lodgepole pine forest, where the lack of lower branches on the trees and the lack of understory creates a wall of poles. Planted pine trees along the cleared edges would develop an open-growth full-branched form, due to the access to sunlight, which would soften the hard edge and increase screening effect. On cut and fill slopes these plantings should be made on the rounded areas at the top or bottom edge of the slope.

Cuts

- A program of revegetation and rehabilitation of cut slopes will be vigorously pursued.

- The project offers an opportunity to mitigate problem cuts on the existing highway with the benefit of current rehabilitation practices. However, second growth vegetation will be retained on existing cuts where ever possible.

- In those areas where there is choice between cutting further into the slope or encroaching on the river, it is preferable from the visual perspective of highway travel and river recreation, to encroach on the river. In many cases the previous highway construction has left the river in a straight-sided, unnatural channel. Additional encroachment on the river could be an opportunity for mitigation of these impacts. New channel alterations could be carried out to achieve a natural-appearing channel---an improvement over the existing situation both visually and, possibly, in terms of aquatic habitat. On the other hand, the existing still, clear backwaters of the river are a visual asset and any encroachment should be minimized.

Long-term Maintenance

- A vital part of the mitigation activities for the project will be to ensure maintenance is carried out that enhances mitigation objectives. The maintenance program will cover such activities as: selective clearing to maintain views, mowing in the right-of-way and the maintenance of cut slope rehabilitation.

5.9.4 ADDITIONAL WORK

Items requiring additional attention include:

- A more detailed visual analysis of alternative highway alignments to identify the best opportunities for improved views of the Bow River and possibly the peaks on the south side of the valley. This would be carried out as part of detailed design.

- Visual problems associated with the lodgepole pine forest type, in terms of edge effects and visual screening, have been described. Additional analysis of the highway corridor vegetation will be carried out so that edge mitigation measures can be planned, and the lanes can be adequately separated to achieve good visual buffering.

- Development of appropriate designs for improving unnatural sections of the Bow River where the highway encroaches upon it. This work would be done in concert with an aquatic biologist and a hydraulic engineer.

- Where large cuts are unavoidable, the development of a suitable rehabilitation programme.

- The availability of suitably sized native plant materials for surface rehabilitation purposes. Lodgepole pine is not a readily available nursery material.

5.9.5 SUMMARY

Beneficial Effects

With east and westbound traffic separated, travellers will partake in greater visual enjoyment of the Park environment. Opportunities exist for wide separation of opposing lanes and curvilinear alignment, which would constitute a substantial improvement over present conditions.

The right-of-way edges on the new alignment will be modulated, providing increased visual variety in the foreground and adding to background views.

A number of existing cuts which presently have visual impacts will be regraded and can therefore receive the benefits of a higher standard of rehabilitation. The northerly exposures and the cool wet climatic regime of the area will facilitate successful revegetation of disturbed areas. The generally high level of natural revegetation of the former disturbances is indicative of this.

The alternative south alignment between km 28.5 and km 33, due to its higher location, would provide more panoramic views of the valley, and also a different visual experience for east and westbound travellers.

If, to avoid excessive cuts the highway fills are permitted to further encroach upon the Bow River at km 51.5 and km 55.5, the present unnatural linear appearance of the river could be improved.

Adverse Effects

Some large cuts will be unavoidable resulting in additional visual impact on the Park landscapes for several years, as viewed from distant points in the Park. Some of the largest cuts would occur on the alternative south alignment between km 28.5 and km 33. The impact of these cuts would be significant when viewed from the Bow Valley Parkway and railway.

The widened highway and cleared right-of-way will generally increase the visual impact when viewed from distant elevated points. The uniform consistent forest cover will exacerbate this impact.

Although some highway travellers would accept open cut slopes without comment or even welcome them as a respite from the relatively uniform forest cover, others would find them unnatural and visually offensive.

Where concrete barriers are unavoidable, the visual experience of most travellers will be impacted by the close proximity of the additional lanes and the barriers.

SECTION 5.10

SOCIO-ECONOMICS

5.10.1 DIRECT CONSTRUCTION IMPACTS

Manpower

Estimated manpower requirements for the project have been given in Section 2.3 (Table 2.3-1).

General contractors retained for each aspect of the construction program will likely come from outside the project region, as local contractors do not have sufficient capacity equipment or manpower to undertake the construction tasks required. However spin-off work from the larger contracts will benefit local contractors.

Project labour costs will total $27.6 million, or approximately 37% of the total capital cost of $74.5 million as projected.

Assuming 10% of the equipment operators and 25% of the labourers are acquired locally, approximately $2.23 million gross income will accrue to regional residents. Allowing for 30% deduction to cover tax, CPP and UIC, this value nets out at $1.56 million.

Population

Small temporary increases in the regional population will occur during the construction period. Only minior impacts are foreseen as existing facilities and services should be able to accommodate.

Housing and Municipal Services

Construction camps will be used to house labourers. These camps will be developed in the context of current Parks Canada guidelines. Municipal services as well as food services will be accommodated by the camp. Reclamation of camp sites will be carried out as they are abandoned.

Traffic Management

During construction, disruption of traffic flow and the need for temporary detours, changes in speed limits and alignment will have adverse effects on travel times and visitor experience.

However, because of the less restrictive nature of the right of way of the TCH from km 27 to km 75, it is anticipated that less interference will be experienced by the traffic than was experienced in Phases I and II.

The use of a special "traffic coordinator" to be supplied by the contractors will be continued.

All signage will be in accordance with the "Uniform Traffic Control Devices Manual for Canada".

1988 Olympic Games

During the 15-day period from February 13-28, 1988 the XV Winter Olympics will be held in Calgary, with event venues at Canmore and Kananaskis Country. Out-of-region visitors will likely visit the Banff-Lake Louise corridor. It is also expected that the shoulder weeks will experience above normal visitation. Every attempt will be made to make the condition of the TCH as convenient as possible during this event.

Dust

Levels of dust are expected to be higher than normal throughout construction periods.

Dust created by traffic will be reduced as much as possible by means of dustpalliatives and watering to mitigate the impact to acceptable levels.

5.10.2 INDIRECT CONSTRUCTION IMPACTS

Regional

The economic benefits ensuing from construction has been assessed using two economic models. The results are shown on Table 5.10-1. "Total Income" includes not only the direct income to construction workers (Section 5.10.2) but also indirect (e.g. suppliers employees) and induced income. The "Increase in Gross Domestic Product" represents the total value of goods and services produced in Alberta as a result of the estimated $74.5 million construction expenditure. The range of values provided in the table result from different applications of the models.

TABLE 5.10-1: ECONOMIC BENEFITS FROM CONSTRUCTION

	PARKS CANADA[1]	ALBERTA BUREAU OF STATISTICS[2]
Total Income (Domestic)*	45.9 - 49.9	48.6 - 50.7
Increase in Gross Domestic Product (GDP) for Alberta*	74.3 - 77.5	69.1 - 70.5
Total Employment (Person Years)	1595 - 1654	1613 - 1687

*In millions of dollars

1 Evaluation of the Economics Impact of Capital Projects using the Statistics Canada Inter-Provincial Input-Output Model, Parks Canada, April 1985.

2 Economic Multipliers for Alberta Industries and Commodities, Alberta Bureau of Statistics, March 1984.

It is clear that the economic benefits associated with construction of the project will be substantial.

Local

Local spending on consumer goods by the construction labour force is expected to be in the order of $960,000 (5% of the net income of the total manpower requirement).

In addition the use of local labour as earlier indicated, and the purchase of sub-contracting services and construction supplies and materials should enhance the local economy as a proportion of the indirect and induced benefits to household income covered above.

The amount of contractor spending on local supplies and materials will be dependent on local availability and thus on the ability of local suppliers to competitively make such provisions.

5.10.3 DIRECT OPERATIONAL IMPACTS

a) TCH User Benefits

The prime benefit upon completion of the improvements will be to the road user. Traffic congestion over the improved section of the highway will be substantially reduced. Consequently, for through commercial traffic and automobiles, travelling time during heavy use periods and associated costs will improve. In addition the improvements will make destinations within the Park more accessible.

b) Maintenance

Increased amounts of pavement and heightened user expectations of flow and safety will result in an increased level of maintenance. This will include maintenance of pavement surfaces and snow removal. It is expected that more maintenance personnel will be required over the long term, and also that greater amounts of equipment and supplies will also result.

c) Visitor Experience

The change to a 4-lane limited access highway will result in unquantifiable changes to the experiences of park visitors. As the majority of visitors have used the private automobile as the basis of their visit to Banff National Park, it can initially be assumed that increased levels of service will enhance rather than detract from their experience. However, there may be some visitors who, notwithstanding the completion of Phases I and II, would perceive the highway as being contradictory to a National Park experience. For these visitors, it is felt that the Bow Valley Parkway would provide a viable alternative.

5.10.4 INDIRECT OPERATIONAL IMPACTS

The following non-quantified effects of the completed project are foreseen:

- traffic safety will be enhanced along the project route; and
- no significant changes are expected in the use characteristics of the major trans-mountain routes. The TCH will likely remain as the most heavily used route;

5.10.5 IMPACT ON TOURISM

Major construction activities will take place during the summer/fall seasons and thus will coincide with the highest use periods, especially by out-of-region visitors. Careful traffic management as described under Section 5.10.2 will mitigate this problem. However there will be a number of periods during specific contracts when traffic delays and other problems will be apparent. Thus, the following impacts can be expected:

- Some out-of-region visitors may postpone return visits.
- Local and regional visitors may avoid short-term visits during high-use periods.
- Assuming a 5 to 6 percent reduction in annual visitation (developed for the Phase II EIS), a net economic cost to the local economy could reach a maximum in the order of $2.4 million per annum. In some years it will be substantially less. (This loss is incorporated into the net economic benefit calculations presented in Section 5.10.1).

The prime benefit of the project following completion is that the resulting relief in traffic congestion will allow normal growth in the local recreation and tourist related activities. In our judgement the project will not necessarily result in any extraordinary growth in Park visitation, since such growth is affected by many external factors. These factors include world oil prices, state of the economy, recreational alternatives, population changes, and restriction on Park accommodation; each of these is as important to growth in Park visitation as improved accessibility resulting from the project.

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The study team responsible for this document was coordinated by Thurber Consultants Ltd. The team was comprised of specialists from Public Works Canada, Parks Canada and the private sector as listed below:

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- Project Details
- Air Quality
- Land Use and Recreation
- Socio Economics and Tourism

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COTTONWOOD CONSULTANTS LTD., (Calgary)
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- Hydrology and Stream Regimes

RENEWABLE RESOURCES CONSULTING SERVICES LTD., (Sidney)
- Wildlife

THURBER CONSULTANTS LTD., (Calgary; Victoria)
- Preparation and assembly of document
- Geology and Terrain
- Regulations and Administrative Procedures

The cover of this report depicts Castle Mountain and was prepared from an original drawing by James Webb, formerly of Public Works Canada.

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